

# **SPECIFICATIONS**

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## **CSA 30 & 32 WELL SITE IMPROVEMENTS AND MANGANESE TREATMENT**

**COUNTY SERVICE AREAS 30 & 32 EL PORVENIR & CANTUA CREEK**

**COUNTY OF FRESNO WESTSIDE GROUNDWATER PROJECT**

**STATE WATER RESOURCES CONTROL BOARD PROJECT NUMBER:  
1000359-005C**

**BUDGET / ACCOUNT: 9172 / 8400 / 91317**



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*Department of Public Works and Planning*

**CONTRACT NUMBER 23-13-C**

# **T A B L E O F C O N T E N T S**

## **COVER SHEET**

## **COUNTY ADOPTION AND ACKNOWLEDGMENT**

Engineer's Signature  
Consultant's Signature

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## **AGREEMENT**

Agreement  
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## **PLANS**

**Contract Number 23-13-C**

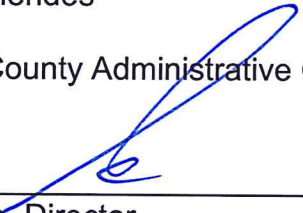
**COUNTY ADOPTION AND ACKNOWLEDGEMENT**

**PROJECT: CSA 30 & 32 WELL SITE IMPROVEMENTS AND MANGANESE TREATMENT**

**CONTRACT NUMBER: 23-13-C**

Sal Quintero, Chairman	3rd District
Nathan Magsig, Vice Chairman	5th District
Brian Pacheco	1st District
Steve Brandau	2nd District
Ernest Buddy Mendes	4th District

Paul Nerland, County Administrative Officer

  
Steven E. White, Director  
Department of Public Works and Planning

8/31/23  
Date

Date Signed: 8/31/23



Supervising Engineer: 

Sebastian Artal, PE C76724

FRESNO COUNTY  
Department of Public Works and Planning  
m/a 2220 Tulare Street, Suite 720  
Fresno, CA 93721-2106

**COUNTY ADOPTION AND ACKNOWLEDGEMENT**

**PROJECT: CSA 30 & 32 WELL SITE IMPROVEMENTS AND MANGANESE TREATMENT**  
**CONTRACT NUMBER: 23-13-C**

Date Signed: 8/31/2023

**Consultant Engineer:** \_\_\_\_\_



Nick Jacobson, PE C84909

Provost & Pritchard  
455 W Fir Avenue  
Clovis, CA 93711

**NOTICE TO BIDDERS**

Sealed proposals will be received at:

<https://www.bidexpress.com/businesses/36473/home>

and at the Fresno County Department of Public Works and Planning (Department), Office of the Design Engineer, Seventh Floor, Fresno County Plaza Building, 2220 Tulare Street, Fresno, CA 93721 until

**2:00 P.M., (1400 hours and 00 seconds)  
Thursday, November 2, 2023**

**If you have any questions about bid submission, please contact us at [DesignServices@fresnocountyca.gov](mailto:DesignServices@fresnocountyca.gov) or calling (559) 600-4241 or (559) 600-4543.**

Promptly following the closing of the bidding all timely submitted bids will be publicly opened and viewable via a livestream (the link for which will be posted at <http://www.fresnocountyca.gov/planholders>) for construction in accordance with the project specifications therefor, to which special reference is made as follows:

**COUNTY SERVICE AREAS 30 & 32 WELL SITE IMPROVEMENTS AND  
MANGANESE TREATMENT**

**STATE WATER RESOURCES CONTROL BOARD PROJECT NUMBER:  
1000359-005C**

**CONTRACT NUMBER 23-13-C**

The project consists of, in general, furnishing all labor, materials and equipment necessary to construct well site improvements at two communities within Fresno County. The work at each location will consist of the demolition of existing facilities, site grading, furnishing and installation of booster pumps, manganese treatment facilities, hydropneumatic tanks, site electrical facilities and incidentals to complete the work described in the Plans and the Specifications.

A pre-bid conference will be held at 10:00 a.m., on September 20, 2023. A discussion of the project will be held and the project sites will be open for examination. Contractors should meet at the park in CSA 30 near intersection of Juarez Ave and El Progreso Ave. Parking is along the street. Meeting will proceed to CSA 32 if needed, along Clarkson Ave, 500 feet west of Clarkson and Terrado Ave intersection. Attendance at the pre-bid is not mandatory; however, the scheduled pre-bid will be the only opportunity for prospective bidders to visit the site in the presence of County staff, and requests for individual site visits with County staff will not be granted.

**Funding for this project has been provided in full or in part by the United States Environmental Protection Agency (USEPA) and the State Water Resources Control Board (SWRCB). The contents of this document do not necessarily reflect the views and policies**

**of the USEPA or the SWRCB, nor does the USEPA or the SWRCB endorse trade names or recommend the use of commercial products mentioned in this document.**

**Bidders are advised that their Good Faith Effort implementation, as described pursuant to the Guidelines for Meeting the California State Revolving Fund (CASRF) Programs Disadvantaged Business Enterprise (DBE) Requirements (Proposal 14 of the Bid Book), will be evaluated to determine bidder responsiveness, regardless of whether fair share objectives have been met. Meeting or exceeding the objectives will not be considered evidence of adequate Good Faith Efforts. Emphasis is placed on the need for contractors to post solicitations for bids or proposals for a minimum of 30 calendar days before the bid opening date. Failure to comply with the Good Faith Efforts requirements will be considered non-responsive.**

The County of Fresno affirms that in any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full opportunity to submit bids in response to this invitation. Bidders are advised that Disadvantaged Business Enterprise (DBE) requirements are included in Section 2, "Bidding," under subsection 2-1.12 "Disadvantaged Business Enterprises (DBEs)".

**This project is subject to the "American Iron and Steel" provisions of the Consolidated Appropriations Act Of 2014. Unless a predominantly iron or steel product qualifies for an exemption, as listed by the United States Environmental Protection Agency, all manufactured iron and steel products must be certified as produced within the United States.**

Bidders may fill out a Request to be Added to Planholders list:

<https://www.fresnocountyca.gov/Departments/Public-Works-and-Planning/Construction-Bidding-Opportunities/Request-to-Be-Added-to-the-Planholders-List-Form>

Requesters will then be listed as a planholder for the project on the website and receive notifications and addenda issued for the project.

Prospective bidders may also select the project on [www.BidExpress.com](http://www.BidExpress.com). Those that demonstrate interest in the project will be added to the planholders list, and receive notifications and addenda issued for the project.

Planholder and exchange/publication names may be obtained from the Fresno County website at <http://www.fresnocountyca.gov/planholders>.

Electronic copies, in ".pdf" file format, of the official project plans and specifications, bid books and proposal sheets, as well as cross sections and such additional supplemental project information as may be provided, are available to view, download, and print at <http://www.fresnocountyca.gov/planholders>.

If a bidder is unable to submit a bid via Bid Express, Bid Books, which contain bid proposal sheets necessary to submit a bid, may be obtained within the Specifications documents posted on the Fresno County website.

Electronic bids shall be submitted via the Bid Express website. Hardcopy bids shall be submitted in a sealed envelope addressed to the Department and labeled with the name of the bidder, the name of the project and the statement "Do Not Open Until The Time Of Bid Opening."

Bid security in the amount of ten (10) percent of the amount of the bid, and in the form of a bid bond issued by an admitted surety insurer licensed by the California Department of Insurance, cash, cashier's check or certified check shall accompany the bid. You must either attach an electronic bid bond or provide an original bid bond (or other form of bid security authorized by Public Contract Code Section 20129(a)), prior to the bid opening. Bid security shall be made in favor of the County of Fresno.

Hardcopy bid bonds shall be submitted in a sealed envelope addressed to the Department and labeled with the name of the bidder, the name of the project and the statement "Do Not Open Until The Time Of Bid Opening – BID BOND"

A Summary of Bids and a list of subcontractors for the apparent low bidder will be posted at the above listed website, generally within 24 hours of the Bid Opening.

All questions regarding this project shall be in writing and shall be received by the Department of Public Works and Planning, Design Division, no later than 2:00 P.M. on the seventh (7th) calendar day before bid opening. Any questions received after this deadline will not receive a response unless the Department of Public Works and Planning elects to issue an addendum to revise the bid opening date. In the event that the bid opening date is revised, the deadline for questions will be extended to no later than 2:00 P.M. on the seventh (7th) calendar day before the revised bid opening date. Questions shall be submitted on the "Request for Clarification Form" provided on our website:

<https://www.fresnocountyca.gov/Departments/Public-Works-and-Planning/Construction-Bidding-Opportunities/23-13-C-CSA-30-32-Well-Site-Improvements-and-Manganese-Treatment/Request-for-Clarification-Form>

Any changes to, or clarification of, the project plans and specifications shall be in the form of a written addendum issued to planholders of record. Questions that prompt a change or clarification shall be included in the addendum with the subsequent answer.

Any oral explanation or interpretations given to this project are not binding.

No contract will be awarded to a contractor who has not been licensed in accordance with the provisions of the Contractors State License Law, California Business and Professions Code, Division 3, Chapter 9, as amended, or whose bid is not on the proposal form included in the contract document. A valid California Contractor's License, **Class A (General Engineering)**, is required for this project.

Pursuant to Section 1773 of the Labor Code, the general prevailing wage rates in the county, or counties, in which the work is to be done have been determined by the Director of the California Department of Industrial Relations. These wages are set forth in the General Prevailing Wage Rates for this project, available at County of Fresno, Department of Public Works and Planning, 2220 Tulare Street, Sixth Floor, Fresno CA 93721-2104 and available from the California Department of Industrial Relations' Internet web site at <http://www.dir.ca.gov/DLSR/PWD>. Future effective general prevailing wage rates, which have been predetermined and are on file with the

California Department of Industrial Relations are referenced but not printed in the general prevailing wage rates.

This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations.

No contractor or subcontractor may be listed on a bid proposal for a public works project unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5 [with limited exceptions from this requirement for bid purposes only under Labor Code section 1771.1(a)].

This contract is subject to state contract nondiscrimination and compliance requirements pursuant to Government Code, Section 12990.

The Federal minimum wage rates for this project as predetermined by the United States Secretary of Labor are set forth in **General Decision Number CA20230018, Dated 09/01/2023**, which is incorporated in these special provisions by this reference as if fully set forth herein and which can be viewed at <https://SAM.gov>, under CA20230018. Said Federal wage rates, as well as project plans, special provisions, and bid forms, may also be examined at the County of Fresno office described in the preceding paragraph. Addenda to modify the reference to Federal minimum wage rates to reflect revisions thereto, if necessary, will be issued to planholders of record.

Attention is directed to the provisions in the “Federal Requirements” section of these specifications. If there is a difference between the minimum wage rates predetermined by the Secretary of Labor and the general prevailing wage rates determined by the Director of the California Department of Industrial Relations for similar classifications of labor, the Contractor and subcontractors shall pay not less than the higher wage rate. The Department will not accept lower State wage rates not specifically included in the Federal minimum wage determinations. This includes "helper" (or other classifications based on hours of experience) or any other classification not appearing in the Federal wage determinations. Where Federal wage determinations do not contain the State wage rate determination otherwise available for use by the Contractor and subcontractors, the Contractor and subcontractors shall pay not less than the Federal minimum wage rate, which most closely approximates the duties of the employees in question.

The U.S. Environmental Protection Agency (EPA) provides a toll-free “hotline” (Telephone No. 1888-546-8740) service to report bid rigging activities. Anyone with knowledge of possible bid rigging, bidder collusion, or other fraudulent activities should use the “hotline” to report these activities. The “hotline” is part of the EPA’s continuing effort to identify and investigate contract fraud and abuse and is operated under the direction of the EPA Inspector General. All information will be treated confidentially and caller anonymity will be respected. Additional information may be obtained at [https://www.epa.gov/office-inspector-general/epa-oig-hotline#file\\_now](https://www.epa.gov/office-inspector-general/epa-oig-hotline#file_now).

The U.S. Department of Transportation (DOT) provides a toll-free “hotline” service to report bid rigging activities. Bid rigging activities can be reported Mondays through Fridays, between 8:00 a.m. and 5:00 p.m., Eastern Time, Telephone No. 1-800-424-9071. Anyone with knowledge of possible bid rigging, bidder collusion, or other fraudulent activities should use the “hotline” to report these activities. The “hotline” is part of the DOT’s continuing effort to identify and investigate highway construction contract fraud and abuse and is operated under the direction of the DOT Inspector General. All information will be treated confidentially and caller anonymity will be respected.



Bids are required for the entire work described herein. Bids will be compared on the basis of the cumulative sum of the bid amounts listed for the individual line items.

The successful bidder shall furnish a faithful performance bond in the amount of 100 percent of the contract amount and a payment bond in the amount of 100 percent of the contract amount. Each bond specified in this Notice (bid bond, faithful performance bond and payment bond) shall meet the requirements of all applicable statutes, including but not limited to those specified in Public Contract Code section 20129 and Civil Code section 3248.

Each bond specified in this Notice shall be issued by a surety company designated as an admitted surety insurer in good standing with and authorized to transact business in this state by the California Department of Insurance, and acceptable to the County of Fresno. Bidders are cautioned that representations made by surety companies will be verified with the California Department of Insurance. Additionally, the County of Fresno, in its discretion, when determining the sufficiency of a proposed surety company, may require the surety company to provide additional information supported by documentation. The County generally requires such information and documentation whenever the proposed surety company has either a Best's Key Rating Guide of less than **A** and a financial size designation of less than **VIII**. Provided, however, that the County expressly reserves its right to require all information and documentation to which the County is legally entitled from any proposed surety company.

The Board of Supervisors reserves the right to reject any or all bids.

Board of Supervisors, County of Fresno

Paul Nerland, County Administrative Officer

Bernice E. Seidel, Clerk of the Board

Issue Date: September 5, 2023

# **Special Provisions**

**DIVISION I GENERAL PROVISIONS**  
**1 GENERAL**

**1-1.01 GENERAL**

**Add to the beginning of Section 1:**

The work is done in accordance with the 2015 *Standard Specifications*, 2015 *Standard Plans* and the following special provisions.

Where these special provisions indicate to replace, add to, delete, delete from, or otherwise modify a "section," or a portion thereof, the section or portion thereof to which such modification is to be applied is the section or portion thereof with the corresponding numbering in the 2015 *Standard Specifications*.

Except to the extent that they may conflict with these special provisions, revised standard specifications apply if included in the project details section of the book entitled "Specifications."

Revised standard plans apply if listed on the "List of Revised Standard Plans," if any, in these special provisions; or if shown or referenced on the project plans or in the project details section of the book entitled "Specifications."

In case of conflict between the *Standard Specifications* and these special provisions, the special provisions shall take precedence over and be used in lieu of such conflicting portions.

In case of conflict between applicable revised standard specifications and these special provisions, the special provisions shall take precedence over and be used in lieu of such conflicting portions.

**Add to the end of section 1-1.01:**

**Bid Items and Applicable Sections**

**Refer to Section 01 22 00 "EXPLANATION OF BID ITEMS"**

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**Add to the 1st table of section 1-1.06:**

APCD	air pollution control district
AQMD	air quality management district
CISS	cast-in-steel shell
CSL	crosshole sonic logging
GGL	gamma-gamma logging
METS	Caltrans Material Engineering and Testing Services

**Add to section 1-1.06:**

Abbreviations in the Bid Item List are also used in Proposal Sheet 2.

**Replace the headings and paragraphs of Section 1-1.07 with:**

**1-1.07 DEFINITIONS**

**1-1.07A General**

Interpret terms as defined in the Contract documents.

**1-1.07B Glossary**

**abandon:** Render unserviceable in place.

**acts of God:** *Acts of God* as defined in Pub Cont Code § 7105.

**activity:** Task, event, or other project element on a schedule that contributes to completing the project. An activity has a description, start date, finish date, duration, and one or more logic ties.

**adjust:** Raise or lower a facility to match a new grade line.

**aerially deposited lead:** Lead primarily from vehicle emissions deposited within unpaved areas or formerly unpaved areas.

**Authorized Facility Audit List:** Caltrans-developed list of facilities. For the Authorized Facility Audit List, go to the METS website.

**authorized laboratory:** Independent testing laboratory (1) not employed or compensated by any subcontractor or subcontractor's affiliate providing other services for the Contract and (2) authorized by the Department.

**Authorized Material List:** Caltrans-developed list of authorized materials. For the Authorized Material List go to the METS website.

**Authorized Material Source List:** Caltrans-developed list of authorized source materials. For the Authorized Material Source List go to the METS website.

**base:** Layer of specified material of planned thickness placed immediately below the pavement or surfacing.

**basement material:** Material in an excavation or embankment under the lowest layer to be placed.

**bid item:** Work unit for which the Bidder provides a price.

**Bid Item List:** List of bid items, units of measure, and the associated quantities. The verified Bid Item List is the Bid Item List with verified prices. The Contract Proposal (Proposal 2) of Low Bidder at the Department's website is the verified Bid Item List. After contract award, interpret a reference to the Bid Item List as a reference to the verified Bid Item List.

**borrow:** Fill acquired from an excavation source outside the described cut area.

1. **local borrow:** Material obtained by widening cuts or excavating from sources outside the planned or authorized cross section on the job site. The location of the local borrow is described or designated by the Engineer.
2. **imported borrow:** Borrow that is not local borrow.

**bridge:** Structure that:

1. Has a bridge number
2. Carries a (1) utility, (2) railroad, or (3) vehicle, pedestrian, or other traffic over, under, or around obstructions or waterways

**building-construction contract:** Contract that has *Building Construction* on the cover of the *Notice to Bidders and Special Provisions*.

**California Test:** Caltrans-developed test for determining work quality. For California Tests, go to the METS website.

**Caltrans:** State of California Department of Transportation

**certificate of compliance:** Certificate stating the material complies with the Contract.

**Certified Industrial Hygienist:** Industrial hygienist certified in comprehensive practice by the American Board of Industrial Hygiene.

**change order work:** Work described in a Change Order, including extra work and work described in the Contract as change order work.

**closure:** Closure of a traffic lane or lanes, including shoulder, ramp, or connector lanes, within a single traffic control system.

**commercial quality:** Quality meeting the best general practices.

**commercial source:** Established business operating as a material source for the general public.

**Contract:** Written and executed contract between the Department and the Contractor.

**Contract acceptance:** Director's written acceptance of a completed Contract.

**Contract time:** Number of original working days as adjusted by any time adjustment.

**Contractor:** Person or business or its legal representative entering into a Contract with the Department for performance of the work.

**controlling activity:** Construction activity that will extend the scheduled completion date if delayed.

**County:** The County of Fresno

**critical path:** Longest continuous chain of activities for the project that has the least amount of total float of all chains. In general, a delay on the critical path extends the scheduled completion date.

**critical path method:** Network-based planning technique using activity durations and relationships between activities to calculate a schedule for the entire project.

**culvert:** Structure other than a bridge that provides an opening under a roadway.

**data date:** Day after the date through which a schedule is current. Everything occurring earlier than the data date is as-built and everything on or after the data date is planned.

**day:** 24 consecutive hours running from midnight to midnight; calendar day.

1. **business day:** Day on the calendar except a Saturday and a holiday.
2. **working day:** Time measure unit for work progress. A working day is any 24-consecutive-hour period except:
  - 2.1. Saturday and a holiday.
  - 2.2. Day during which you cannot perform work on the controlling activity for at least 50 percent of the scheduled work shift with at least 50 percent of the scheduled labor and equipment due to any of the following:
    - 2.2.1. Adverse weather-related conditions.
    - 2.2.2. Traffic maintenance under the Contract.
    - 2.2.3. Suspension of a controlling activity that you and the Engineer agree benefits both parties.
    - 2.2.4. Unanticipated event not caused by either party, such as:
      - 2.2.4.1. Act of God
      - 2.2.4.2. Act of a public enemy.
      - 2.2.4.3. Epidemic.
      - 2.2.4.4. Fire.
      - 2.2.4.5. Flood.
      - 2.2.4.6. Governor-declared state of emergency.
      - 2.2.4.7. Landslide.
      - 2.2.4.8. Quarantine restriction.
    - 2.2.5. Issue involving a third party, including:
      - 2.2.5.1. Industry or area-wide labor strike.
      - 2.2.5.2. Material shortage.
      - 2.2.5.3. Freight embargo.
      - 2.2.5.4. Jurisdictional requirement of a law enforcement agency.
      - 2.2.5.5. Workforce labor dispute of a utility or nonhighway facility owner resulting in a nonhighway facility rearrangement not described and not solely for the

Contractor's convenience. Rearrangement of a nonhighway facility includes installation, relocation, alteration, or removal of the facility.

- 2.3. Day during a concurrent delay.
3. **original working days:**
  - 3.1. Working days to complete the work shown on the *Notice to Bidders* for a non-cost-plus-time-based bid
  - 3.2. Working days bid to complete the work for a cost-plus-time-based bid

Where working days is specified without the modifier *original* in the context of the number of working days to complete the work, interpret the number as the number of original working days as adjusted by any time adjustment.

**deduction:** Money permanently taken from a progress payment or the final payment. Deductions are cumulative and are not retentions under Pub Cont Code § 7107.

**delay:** Event that extends the completion of an activity.

1. **excusable delay:** Delay caused by the Department and not reasonably foreseeable when the work began, such as:
  - 1.1. Change in the work
  - 1.2. Department action that is not part of the Contract
  - 1.3. Presence of an underground utility main not described in the Contract or in a location substantially different from that specified
  - 1.4. Described facility rearrangement not rearranged as described, by the utility owner by the date specified, unless the rearrangement is solely for the Contractor's convenience
  - 1.5. Department's failure to obtain timely access to the right-of-way
  - 1.6. Department's failure to review a submittal or provide notification in the time specified
2. **critical delay:** Excusable delay that extends the scheduled completion date
3. **concurrent delay:** Occurrence of at least 2 of the following events in the same period of time, either partially or entirely:
  - 3.1. Critical delay
  - 3.2. Delay to a controlling activity caused by you
  - 3.3. Non-working day

**Department:** The Fresno County Board of Supervisors and its authorized representatives.

**District Office:** County of Fresno Department of Public Works and Planning

**detour:** Temporary route for traffic around a closed road part. A passageway through a job site is not a detour.

**Director:** Department's Chairman

**disadvantaged business enterprise:** Disadvantaged business enterprise as defined in 49 CFR 26.5.

**dispose of:** Remove from the job site.

**divided highway:** Highway with separated traveled ways for traffic, generally in opposite directions.

**Engineer:** The County's Director of Public Works and Planning, acting through their authorized designees.

**early completion time:** Difference in time between an early scheduled completion date and the work completion date.

**environmentally sensitive area:** Area within or near construction limits where access is prohibited or limited to protect environmental resources.

**estimated cost:** Estimated cost of the project as shown on the *Notice to Bidders*.

**extra work:** Any work, desired or performed, but not included in the original Contract.

**federal-aid contract:** Contract that has a federal-aid project number on the cover of the *Specifications*.

**final pay item:** Bid item whose quantity shown on the Bid Item List is the quantity paid.

**finished grade:** Final surface of the completed facility. If the work under the Contract includes stage construction, the relation between the finished grade and the work under the Contract is shown.

**fixed cost:** Labor, material, or equipment cost directly incurred by the Contractor as a result of performing or supplying a particular bid item that remains constant regardless of the item's quantity.

**float:** Difference between the earliest and latest allowable start or finish times for an activity.

1. **Department-owned float:** Time saved on the critical path by actions of the Department. It is the last activity shown on the schedule before the scheduled completion date.

**force account work:** Work ordered on a construction project without an existing agreement on its cost, and performed with the understanding that the contractor will bill the owner according to the cost of labor, materials, and equipment, plus a certain percentage for overhead and profit.

**grading plane:** Basement material surface on which the lowest layer of subbase, base, pavement, surfacing, or other specified layer is placed.

**highway:** Whole right-of-way or area reserved for use in constructing the roadway and its appurtenances.

**holiday:** Holiday shown in the following table:

<b>Holidays</b>	
Holiday	Date observed
Every Sunday	Every Sunday
New Year's Day	January 1 <sup>st</sup>
Birthday of Martin Luther King, Jr.	3rd Monday in January
Presidents' Day	3rd Monday in February
Cesar Chavez Day	March 31 <sup>st</sup>
Memorial Day	Last Monday in May
Independence Day	July 4 <sup>th</sup>
Labor Day	1st Monday in September
Veterans Day	November 11 <sup>th</sup>
Thanksgiving Day	4th Thursday in November
Day after Thanksgiving Day	Day after Thanksgiving Day
Christmas Day	December 25 <sup>th</sup>

If January 1st, March 31st, July 4th, November 11th, or December 25th fall on a Sunday, the Monday following is a holiday. If January 1st, March 31st, July 4th, November 11th, or December 25th fall on a Saturday, the preceding Friday is a holiday.

**hours of darkness:** Hours of darkness as defined in Veh Code § 280.

**idle equipment:** Equipment:

1. On the job site at the start of a delay
2. Idled because of the delay
3. Not operated during the delay

**informal-bid contract:** Contract that has *Informal Bid Authorized by Pub Cont Code § 10122* on the cover of the *Notice to Bidders and Special Provisions*.

**job site:** Area within the defined boundaries of a project.

**Labor Surcharge and Equipment Rental Rates:** Caltrans publication that lists labor surcharge and equipment rental rates.

**landscaping:** Practice of a landscaping contractor under 16 CA Code of Regs § 832.27.

**material:** Any product or substance specified for use in the construction of a project.

**material shortage:**

1. Shortage of raw or produced material that is area-wide and caused by an unusual market condition except if any of the following occurs:
  - 1.1. Shortage relates to a produced, nonstandard material
  - 1.2. Supplier's and the Contractor's priority for filling an order differs
  - 1.3. Event outside the United States for a material produced outside the United States
2. Unavailability of water that delays a controlling activity

**material source facility audit:** Self-audit and a Caltrans audit evaluating a facility's capability to consistently produce materials that comply with Caltrans standards.

**median:** Portion of a divided highway separating the traveled ways including inside shoulders.

**milestone:** Event activity that has zero duration and is typically used to represent the start or end of a certain stage of the project.

**mobilization:** Preparatory work that must be performed or costs incurred before starting work on the various items on the job site (Pub Cont Code § 10104).

**modify:** Add to or subtract from an appurtenant part.

**narrative report:** Document submitted with each schedule that discusses topics related to project progress and scheduling.

**near critical path:** Chain of activities with total float exceeding that of the critical path but having not more than 10 working days of total float.

**obliterate:** Place an earth cover over or root, plow, pulverize, or scarify.

**Office engineer:** The Director of Public Works and Planning for the County of Fresno

**pavement:** Uppermost layer of material placed on a traveled way or shoulder.

**plans:** Standard plans, revised standard plans, and project plans.

1. **standard plans:** Drawings standard to Department construction projects. These plans are in a book titled *Standard Plans*.
2. **revised standard plans:** New or revised standard plans. These plans are listed in the *List of Revised Standard Plans* in a book titled *Specifications*.
3. **project plans:** Drawings specific to the project, including authorized shop drawings. These plans also include a section titled *Project Details* of a book titled *Specifications*.

**plant establishment period:** Number of days shown on the *Notice to Bidders* for plant establishment.

**quality characteristic:** Characteristic of a material that is measured to determine conformance with a given requirement.

**quality control plan:** Contractor's plan to ensure QC.

**reconstruct:** Remove and disassemble and construct again at an existing or new location.

**relocate:** Remove and install or place in a new location.

**remove:** Remove and dispose of.



**reset:** Remove and install or place laterally at the same station location.

**roadbed:** Roadway portion extending from the curb line to curb line or the shoulder line to shoulder line. A divided highway has 2 roadbeds.

**roadside:** Area between the outside shoulder edge and the right-of-way limits.

**roadway:** Portion of the highway within the outside lines of curbs, sidewalks, slopes, ditches, channels, or waterways. A roadway includes the structures and features necessary for safety, protection of facilities, and drainage.

**salvage:** Remove, clean, and haul to a specified location.

**schedule:**

1. **baseline schedule:** Initial schedule showing the original work plan starting on the date of Contract approval. This schedule shows no completed work to date and no negative float or negative lag to any activity.
2. **revised schedule:** Schedule that incorporates a proposed or past change to logic or activity durations.
3. **updated schedule:** Current schedule developed from the accepted baseline and any subsequent accepted updated or revised schedules through regular monthly review to incorporate actual past progress.

**scheduled completion date:** Planned work completion date shown on the current schedule.

**shoulder:** Roadway portion contiguous with the traveled way for accommodation of a stopped vehicle, emergency use, and lateral support of base and surface courses.

**small tool:** Tool or piece of equipment not listed in Labor Surcharge and Equipment Rental Rates that has a replacement value of \$500 or less.

**specifications:** Standard specifications, revised standard specifications, and special provisions.

1. **standard specifications:** Specifications standard to Department construction projects. These specifications are in a book titled *Standard Specifications*.
2. **revised standard specifications:** New or revised standard specifications. These specifications are in a section titled *Revised Standard Specifications* of a book titled *Specifications*.
3. **special provisions:** Specifications specific to the project. These specifications are in a section titled *Special Provisions* of a book titled *Specifications*.
4. **general requirements:** Requirements specific to the project. These requirements are in a section titled *General Requirements* of a book titled *Specifications*.
5. **technical specifications:** Specifications specific to the project. These specifications are in a section titled *Technical Specifications* of a book titled *Specifications*.

**State:** State of California, including its agencies, departments, or divisions whose conduct or action is related to the work.

**Structure Design:** Offices of Structure Design of the Department of Transportation.

**subbase:** Layer of material between a base and the basement material.

**subgrade:** Roadbed portion on which pavement, surfacing, base, subbase, or a layer of any other material is placed.

**submittal:**

1. **action submittal:** Written and graphic information and samples that require the Department's response.
2. **informational submittal:** Written information that does not require the Department's response.

**substantial defects:** Defects plainly seen as damaged, displaced, or missing parts or improper functioning of materials, parts, equipment, or systems.

**substructure:** Bridge parts below the bridge seats, pier tops, and haunches for rigid-framed bridges or spring lines for arched bridges; includes abutment backwalls, abutment parapets, and wingwalls.

**superstructure:** Bridge parts except the substructure.

**supplemental project information:** Information relevant to the project, specified as supplemental project information, and made available to bidders.

**surfacing:** Uppermost layer of material placed on a traveled way or shoulders; pavement.

**time impact analysis:** Analysis using a CPM schedule developed specifically to demonstrate the effect a proposed or past change or delay has on the current scheduled completion date.

**time-scaled network diagram:** Graphic depiction of a CPM schedule comprised of activity bars with relationships for each activity represented by arrows. The tail of each arrow connects to the activity bar for the predecessor and points to the successor.

**total bid:** Sum of the item totals as verified by the Department; original Contract price.

**total float:** Amount of time that an activity or chain of activities can be delayed before extending the scheduled completion date.

**traffic:** Pedestrians, bicyclists, ridden or herded animals, vehicles, streetcars, and other conveyances either singularly or together while using any highway for purposes of travel.

**traffic lane:** Portion of traveled way used for the movement of a single line of vehicles.

**traveled way:** Portion of the roadway for the movement of vehicles, exclusive of the shoulders, berms, sidewalks, and parking lanes.

**tunnel:** Tunnel as defined in 8 CA Code of Regs § 8405 et seq.

**unauthorized work:** Work performed beyond the lines and grades described in the Contract or established by the Engineer or extra work performed without Department authorization.

**unsuitable material:** Material encountered below the natural ground surface in embankment areas or below the grading plane in excavation areas that the Engineer determines to be in any of the following conditions:

1. Of such unstable nature that it cannot be compacted to the specified density using ordinary methods at optimum moisture content.
2. Too wet to be properly compacted and cannot be dried before incorporating it into the work. Excessive moisture alone is not sufficient cause for determining that the material is unsuitable.
3. Inappropriate for the planned use.

**withhold:** Money temporarily or permanently taken from a progress payment.

**work:** Resources and activities required for Contract acceptance, including labor, materials, equipment, and the created product.

**work plan:** Detailed formulation of a program of action.

**work zone:** Area of a highway with construction, maintenance, or utility work activities.

#### **1-1.08 DISTRICTS**

##### **Add to the end of Section 1-1.09**

This project is not in a freeze-thaw area.

**Replace the headings and paragraphs of Section 1-1.10 with:**

**1-1.10 PAVEMENT CLIMATE REGIONS**

To help account for the effects of various climatic conditions on pavement performance, the State has been divided into 9 climate regions. The project's pavement climate region is inland valley.

**Replace the headings and paragraphs of Section 1-1.11 with:**

**1-1.11 WEBSITES, ADDRESSES, AND TELEPHONE NUMBERS**

**Websites, Addresses, and Telephone Numbers**

Reference or agency or department unit	Website	Address	Telephone no.
Authorized Material Lists Authorized Material Source Lists	<a href="https://dot.ca.gov/programs/engineering-services/authorized-materials-lists">https://dot.ca.gov/programs/engineering-services/authorized-materials-lists</a>	--	--
CA Unified Certification Program's list of certified DBEs	<a href="https://dot.ca.gov/programs/civil-rights/dbe-search">https://dot.ca.gov/programs/civil-rights/dbe-search</a>	--	--
<i>California MUTCD</i>	<a href="https://dot.ca.gov/programs/safety-programs/camutcd">https://dot.ca.gov/programs/safety-programs/camutcd</a>	--	--
Data Interchange for Materials Engineering	<a href="https://dime.dot.ca.gov/">https://dime.dot.ca.gov/</a>	Materials Engineering and Testing Services Department of Transportation 5900 Folsom Blvd Sacramento CA 95819-4612	(916) 227- 5238
Department	<a href="https://www.fresnocountyca.gov/Departments/Public-Works-and-Planning">https://www.fresnocountyca.gov/Departments/Public-Works-and-Planning</a>	2220 Tulare Street Design Division – Seventh Floor Fresno, CA 93721	(559) 600-9908
Department of Conservation, Office of Mine Reclamation	<a href="http://www.conservation.ca.gov/dmr/">http://www.conservation.ca.gov/dmr/</a>	--	--
Department of General Services, Office of Small Business and DVBE Services	<a href="https://www.dgs.ca.gov/OBAS">https://www.dgs.ca.gov/OBAS</a>	Office of Small Business and DVBE Services Department of General Services 707 3rd St West Sacramento CA 95605- 2811	(800) 559- 5529 (916) 375- 4940
Department of Industrial Relations	<a href="http://www.dir.ca.gov">http://www.dir.ca.gov</a>	455 Golden Gate Ave San Francisco CA 94102	--
Design Services - Contract Administration, Planholders, Bid Results	<a href="https://www.fresnocountyca.gov/Departments/Public-Works-and-Planning/Construction-Bidding-Opportunities">https://www.fresnocountyca.gov/Departments/Public-Works-and-Planning/Construction-Bidding-Opportunities</a>	2220 Tulare Street Design Division – Seventh Floor Fresno, CA 93721	Tel: (559) 600-4241 Fax: (559) 455-4609 Email: <a href="mailto:DesignServices@fresnocountyca.gov">DesignServices@fresnocountyca.gov</a>
Division of Accounting, Office of External Accounts Payable	<a href="https://dot.ca.gov/programs/accounting">https://dot.ca.gov/programs/accounting</a>	Major Construction Payment and Information Unit Office of External Accounts Payable Division of Accounting Department of Transportation P.O. Box 168043 Sacramento, CA 95816-8043	(916) 227-9013
Division of Construction	<a href="http://www.dot.ca.gov/hq/construc/">http://www.dot.ca.gov/hq/construc/</a>	--	--

Geotechnical Services	<a href="https://dot.ca.gov/programs/engineering-services">https://dot.ca.gov/programs/engineering-services</a>	Geotechnical Services Department of Transportation 5900 Folsom Blvd Sacramento, CA 95819-4612	(916) 227-7000
METS	<a href="https://dot.ca.gov/programs/engineering-services">https://dot.ca.gov/programs/engineering-services</a>	Materials Engineering and Testing Services Department of Transportation 5900 Folsom Blvd Sacramento, CA 95819-4612	(916) 227-7000
MPQP	<a href="https://dot.ca.gov/programs/construction/material-plant-quality-program">https://dot.ca.gov/programs/construction/material-plant-quality-program</a>	--	--
Office Engineer	--	Director of Public Works & Planning Fresno County 2220 Tulare St, 8 <sup>th</sup> Floor Fresno, CA 93721	(559) 600-4078

**Replace the headings and paragraphs of Section 1-1.12 with the following:**

**1-1.12 MISCELLANY**

Make checks and bonds payable to the County of Fresno.

**2 BIDDING**

**Replace the headings and paragraphs of Section 2 with the following:**

**2-1.01 GENERAL**

Section 2 includes specifications related to bid eligibility and the bidding process.

**2-1.02 BID INELIGIBILITY**

A firm that has provided architectural or engineering services to the Department for this contract before bid submittal for this contract is prohibited from any of the following:

1. Submitting a bid
2. Subcontracting for a part of the work
3. Supplying materials

**2-1.03 CONTRACTOR REGISTRATION**

No contractor or subcontractor may be listed on a bid proposal for a public works project unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5 [with limited exceptions from this requirement for bid purposes only under Labor Code section 1771.1(a)].

**2-1.04–2-1.05 RESERVED**

**2-1.06 BID DOCUMENTS**

**2-1.06A General**

The *Bid* book includes bid forms and certifications and may be requested from Design Services and are available online at <http://www.BidExpress.com>.

The *Specifications* includes the *Notice to Bidders*, revised standard specifications, project details, and special provisions.

The *Specifications*, project plans, and any addenda to these documents may be accessed at Design Services.

The *Standard Specifications* and *Standard Plans* may be purchased at the Publication Distribution Unit or accessed online at <https://www.fresnocountyca.gov/files/sharedassets/county/vision-files/files/58025-2015-standard-specifications.pdf>.

**2-1.06B Supplemental Project Information**

The Department makes the following supplemental project information available:

<b>Supplemental Project Information</b>	
Where Available	Description
Included in Project Details	Location Map Construction Project Informational Signs Staking request form PG&E Rule 16 Building, Electrical & Plumbing Permits
Available on Design Services webpage	School Pipeline as-built plans, Pothole report, Geotechnical Report

If as-built drawings are available, they may not show existing dimensions and conditions. Where new construction dimensions are dependent on existing bridge dimensions, verify the field dimensions and adjust the dimensions of the work to fit the existing conditions.

**2-1.06C–2-1.06D Reserved**

**2-1.07 JOB SITE AND DOCUMENT EXAMINATION**

Examine the job site and bid documents. Notify the Department of apparent errors and patent ambiguities in the plans, specifications, and Bid Item List. Failure to do so may result in rejection of a bid or rescission of an award.

Bid submission is your acknowledgment that you have examined the job site and bid documents and are satisfied with:

1. General and local conditions to be encountered
2. Character, quality, and scope of work to be performed
3. Quantities of materials to be furnished
4. Character, quality, and quantity of surface and subsurface materials or obstacles
5. Requirements of the contract

**2-1.08 RESERVED**

**2-1.09 BID ITEM LIST**

Submit a bid based on the bid item quantities the Department shows on Bid Item List.

**2-1.10 SUBCONTRACTOR LIST**

On the Subcontractor List form, list each subcontractor to perform work in an amount in excess of 1/2 of 1 percent of the total bid or \$10,000, whichever is greater (Pub Cont Code § 4100 et seq.).

For each subcontractor listed, the Subcontractor List form must show:

1. Business name and the location of its place of business.
2. California contractor license number for a non-federal-aid contract.
3. Public works contractor registration number.
4. Portion of work it will perform. Show the portion of the work by:
  - 4.1. Bid item numbers for the subcontracted work
  - 4.2. Percentage of the subcontracted work for each bid item listed
  - 4.3. Description of the subcontracted work if the percentage of the bid item listed is less than 100 percent

### **2-1.11 RESERVED**

### **2-1.12 DISADVANTAGED BUSINESS ENTERPRISES (DBEs)**

#### **2-1.12A General**

Section 2-12 is applicable to this contract.

Under 40 CFR 33:

The contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this contract. The contractor shall carry out applicable requirements of 40 CFR part 33 in the award and administration of contracts awarded under EPA financial assistance agreements. Failure by the contractor to carry out these requirements is a material breach of this contract which may result in the termination of this contract or other legally available remedies.

Include this assurance in each subcontract you sign with a subcontractor.

#### **2-1.12B Good Faith Efforts**

You are required to make and demonstrate the following good faith efforts whenever procuring construction, equipment, services and supplies, even if it has achieved the fair share objective:

1. Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through solicitation, outreach and recruitment activities.
2. Make information on forthcoming opportunities available to DBEs and arrange time frames to establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. This includes, whenever possible, posting solicitations for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.
3. Consider in the contracting process, whether firms competing for large contracts could subcontract with DBEs. This could include dividing tasks, when economically feasible, into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.
4. Encourage contracting with a consortium of DBEs when a contract is too large for one firm to handle individually.
5. Use the services and assistance of the Small Business Administration and the Minority Business Development Agency of the Department of Commerce.

Failure to take the steps outlined above prior to bid opening, and to submit the documents specified in Section 2-1.33, shall cause the bid to be rejected as non-responsive.

#### **2-1.12C Fair Share Objectives**

A fair share objective has been adopted for this project, as required by 40 CFR 33. The objective is not a quota or binding requirement. Meeting the objective will not exempt you from employing and demonstrating the mandatory Good Faith Efforts in Section 2-1.12B for any subcontract, and you will not be penalized or treated as if out of compliance if you do not meet the goal.

### **2-1.13–2-1.30 RESERVED**

#### **2-1.31 RESERVED**

#### **2-1.32 RESERVED**

### **2-1.33 BID DOCUMENT COMPLETION AND SUBMITTAL**

#### **2-1.33A General**

Complete forms in the *Bid* book.

Submit an electronic bid online at <http://www.BidExpress.com> (Section 2-1.33D) or submit a hardcopy bid:

1. Under sealed cover

2. Marked as a bid
3. Identifying the contract number and the bid opening date

Certain bid forms must be submitted with the bid and properly executed.

Certain other forms and information must be submitted either with the bid or within the prescribed period after bid opening as specified elsewhere in these special provisions.

Failure to submit the forms and information as specified results in a nonresponsive bid.

If an agent other than the authorized corporation officer or a partnership member signs the bid, file a Power of Attorney with the Department either before opening bids or with the bid. Otherwise, the bid may be nonresponsive.

### **2-1.33B Bid Item List and Bid Comparison**

Submit a bid based on the bid item quantities the Department shows on Proposal 2. Bids will be evaluated and the low bidder determined as indicated in the *Notice to Bidders*.

Do not submit an unbalanced bid. An unbalanced bid is one in which one or more bid items is/are considered by the Department to have been bid at an amount that is unreasonably high or unreasonably low. A bid may be considered to be non-responsive and may be rejected if it is considered by the Department to be unbalanced.

### **2-1.33C Bid Document Completion**

Proposal items are identified by title and by the word "Proposal" followed by the number assigned to the proposal item in question. Proposal items are included in the *Bid Book*.

#### **2-1.33C(1) Proposal 1 - Proposal to the Board of Supervisors of Fresno County**

#### **2-1.33C(2) Proposal 2 - Bid Item List**

One or more sheet(s) or list(s) upon which the bidder completes the bid.

Fill out completely including a unit price and total for each unit price-based item and a total for each lump sum item.

Do not make any additions such as "plus tax", "plus freight", or conditions such as "less 2% if paid by 15th".

Use ink or typewriter for paper bids.

#### **2-1.33C(3) Proposal 3 - Evaluation of Bid Item List**

Describes how inconsistencies and irregularities are evaluated and corrected when Design Services reviews the Bid Item List.

#### **2-1.33C(4) Proposal 4 - Bid Security and Signature**

Submit one of the following forms of bidder's security equal to at least 10 percent of the bid:

- Cash
- Cashier's check
- Certified check
- Signed bidder's bond by an admitted surety insurer

Indicate type of bid security provided.

- Cash – Acceptable but not recommended. Cash is deposited in a clearing account and is returned to bidders by County warrant. This process may take several weeks.



- Cashier's or Certified Checks. This type of security is held until the bid is no longer under consideration. If submitted by a potential awardee, they will be returned when the contract is fully executed by the bidder and bonds and insurance have been approved.
- Bid Bonds - Must be signed by the bidder and by the attorney-in-fact for the bonding company. Provide notarized signature of attorney-in-fact accompanied by bonding company's affidavit authorizing attorney-in-fact to execute bonds. An unsigned bid bond will be cause for rejection.

Provide contractor's license information.

State business name and if business is a:

- Corporation - list officers
- Partnership - list partners
- Joint Venture - list members; if members are corporations or partnerships, list their officers or partners.
- Individual - list Owner's name and firm name style

Signature of Bidder - the following lists types of companies and corresponding authorized signers.

- Corporation - by an officer
- Partnership - by a partner
- Joint Venture - by a member
- Individual - by the Owner

If signature is by a Branch Manager, Estimator, Agent, etc., the bid must be accompanied by a power of attorney authorizing the individual to sign the bid in question or to sign bids more generally, otherwise the bid may be rejected.

Business Address - Firm's Street Address

Mailing Address - P.O. Box or Street Address

Complete, sign, and return with bid.

### **2-1.33C(5) Proposal 5 - Noncollusion Declaration**

Must be completed, signed, and returned with bid.

### **2-1.33C(6) Proposal 6 - Public Contract Code Section 10285.1 Statement**

Select "has" or "has not" in accordance with instructions on form, return with completed for with bid. Note that signing the bid constitutes signing this statement.

### **2-1.33C(7) Proposal 7 - Public Contract Code Section 10162 Questionnaire And Public Contract Code 10232 Statement**

Select: "yes" or "no" accordance with instructions on form, include explanation if "yes" is selected. Return completed form with bid. Note that signing the bid constitutes signing this questionnaire and statement.

### **2-1.33C(8) Proposal 8(a) through Proposal 8(f) - Subcontractors**

Sheet(s) or spaces where bidders list subcontractors. List each subcontractor to perform work in an amount in excess of 1/2 of 1 percent of the total bid or \$10,000, whichever is greater (Pub Cont Code § 4100 et seq.).

The *Subcontractor List* submitted with the bid must show the name, location of business, work portions to be performed, and the contractor's license number for each subcontractor listed.

- Use subcontractor's business name style as registered with the License Board.

- Specify the city in which the subcontractor's business is located and the state if other than California.
- Description of the work to be performed by the subcontractor. Indicate with bid item numbers from the bid sheet and/or work descriptions similar to those on bid item list.
- List license number and Department of Industrial Relations registration number for each subcontractor.

Upon request from Design Services, provide the following additional information within 24 hours of bid opening if not included on the *Subcontractor List* submitted with the bid:

- Complete physical address for each subcontractor listed.
- Percentage of the total bid or dollar amount associated with each subcontractor listed.

**2-1.33C(9) Proposal 9 - Certification With Regard To The Performance Of Previous Contracts Or Subcontracts Subject To The Equal Opportunity Clause And The Filing Of Required Reports**

For a Federal-aid contract, complete, sign, and return with bid. Certification of proposed subcontractors is the responsibility of the Bidder and must be provided to the County upon request.

**2-1.33C(10) Proposal 10 - Title 49, Code Of Federal Regulations, Part 29 Debarment And Suspension Certification**

For a Federal-aid contract, complete, sign, and return with bid. Certification of proposed subcontractors is the responsibility of the Bidder and must be provided to the County upon request.

**2-1.33C(11) Proposal 11 - Nonlobbying Certification For Federal-Aid Contracts**

For a Federal-aid contract, complete, sign, and return with bid.

**2-1.33C(12) Proposal 12(a) through Proposal 12(b) - Disclosure Of Lobbying Activities**

For a Federal-aid contract, complete, sign, and return with bid.

**2-1.33C (13) Proposal 13(a) through Proposal 13(b) - Exhibit 15-G Local Agency Bidder DBE Commitment (Construction Contracts)**

For a Federal-aid contract, bidders must complete and submit so that it is received by Design Services, no later than 4:00 PM on the fifth calendar day after the bid opening if not submitted with the bid.

**2-1.33C(14) Proposal 14(a) through proposal 14(c) - Exhibit 15-H DBE Information — Good Faith Efforts**

For a Federal-aid contract, if you have not met the DBE goal, bidders must complete and submit so that it is received by Design Services no later than 4:00 PM on the fifth calendar day after the bid opening if not submitted with the bid.

**2-1.33C(15) Proposal 15(a) through Proposal 15(b) – Exhibit 12-B Bidder's List of Subcontractor (DBE and Non-DBE)**

For a Federal-aid contract, bidders must submit so that it is received by Design Services, no later than 4:00 PM on the fifth (5th) calendar day after the bid opening if not submitted with the bid. Fill out as completely as possible.

**2-1.33C(16) Proposal 16 - Opt out of payment adjustments for price index fluctuations**

Not Used

### **2-1.33C(17) Proposal 17 - Guaranty**

Does not need to be signed with the bid. Part of the contract which must be signed by the contractor when contract is executed.

### **2-1.33D Electronic Bid Document Completion**

Electronic versions of the bid book documents are available online at <http://www.BidExpress.com>, and may be submitted through that website.

You must either attach an electronic bid bond or provide an original bid bond (or other form of bid security authorized by Public Contract Code Section 20129(a)), prior to the bid opening.

Bidders submitting online may use one of the accepted electronic sureties (SurePath or Surety 2000) to submit their bid bond; or may submit cash, cashier's check, certified check, or a bidder bond to Design Services at 2220 Tulare St., Seventh Floor, Fresno, CA 93721. Those submitting bid bonds directly to Design Services must submit their bid bond:

1. Under sealed cover
2. Marked as a bid-bond
3. Identifying the contract number and the bid opening date on the cover

### **2-1.34 BIDDER'S SECURITY**

Submit one of the following forms of bidder's security equal to at least 10 percent of the bid:

1. Cash
2. Cashier's check
3. Certified check
4. Signed bidder's bond by an admitted surety insurer

Submit cash, cashier's check, certified check, or bidder's bond with your bid.

### **2-1.35–2-1.39 RESERVED**

#### **2-1.40 BID WITHDRAWAL**

1. An authorized agent may withdraw a bid before the bid opening date and time by submitting a written bid withdrawal request at the location where the bid was submitted. Withdrawing a bid does not prevent you from submitting a new bid. An authorized agent is an individual authorized to submit a bid.
2. After the bid opening time, you cannot withdraw a bid.

### **2-1.41–2-1.42 RESERVED**

#### **2-1.43 BID OPENING**

The Department publicly opens and reads bids at the time and place shown on the *Notice to Bidders*.

### **2-1.44–2-1.45 RESERVED**

#### **2-1.46 DEPARTMENT'S DECISION ON BID**

The Department's decision on the bid amount is final.

The Department may reject:

1. All bids
2. A nonresponsive bid

#### **2-1.47 BID RELIEF**

The Department may grant bid relief under Pub Cont Code § 5100 et seq. Submit any request for bid relief to Design Services.

**2-1.48 RESERVED**

**2-1.49 SUBMITTAL FAILURE HISTORY**

The Department considers a bidder's past failure to submit documents required after bid opening in determining a bidder's responsibility.

**2-1.50 BID RIGGING**

Section 2-1.50 applies to a federal-aid contract.

The U.S. Environmental Protection Agency (EPA) provides a toll-free "hotline" (Telephone No. 1-888-546-8740) service to report bid rigging activities. Anyone with knowledge of possible bid rigging, bidder collusion, or other fraudulent activities should use the "hotline" to report these activities. The "hotline" is part of the EPA's continuing effort to identify and investigate contract fraud and abuse and is operated under the direction of the EPA Inspector General. All information will be treated confidentially and caller anonymity will be respected. Additional information may be obtained at [https://www.epa.gov/office-inspector-general/epa-oighotline#what\\_to\\_report](https://www.epa.gov/office-inspector-general/epa-oighotline#what_to_report).

**2-1.51 DISCLOSURE OF SELF-DEALING TRANSACTIONS**

This provision is only applicable if the contractor is operating as a corporation (a for-profit or non-profit corporation) or if during the term of this agreement, the contractor changes its status to operate as a corporation.

Members of the contractor's Board of Directors shall disclose any self-dealing transactions that they are a party to while contractor is providing goods or performing services under this agreement. A self-dealing transaction shall mean a transaction to which the contractor is a party and in which one or more of its directors has a material financial interest. Members of the Board of Directors shall disclose any self-dealing transactions that they are a party to by completing and signing a Self-Dealing Transaction Disclosure Form which is included in *Project Details* of these special provisions.

In the event that the Contractor (to whom the project is awarded) is operating as a corporation or incorporates during the course of the construction contract, and any member of its board of directors is engaged or intends to become engaged in self-dealing transaction(s), each member of its board of directors who is engaged or intends to become engaged in a self-dealing transaction or transactions must complete and submit to the County a completed Self-Dealing Transaction Disclosure Form (in *Project Details*) for each such transaction prior to engaging therein or immediately thereafter.

**3 CONTRACT AWARD AND EXECUTION**

**Replace the headings and paragraphs of Section 3 with:**

**3-1.01 GENERAL**

Section 3 includes specifications related to contract award and execution.

**3-1.02 CONSIDERATION OF BIDS**

**3-1.02A General**

Bids will be compared on the basis listed in the Notice to Bidders.

**3-1.02B Tied Bids**

The Department breaks a tied bid with a coin toss:

**3-1.03 CONTRACTOR REGISTRATION**

No contractor or subcontractor may be awarded a contract for public work on a public works project (awarded on or after April 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.

**3-1.04 CONTRACT AWARD**

**3-1.04A BID PROTEST PROCEDURES**

Any bid protest must be submitted in writing and delivered by the Bidder by either of the following means: (1) via e-mail to [DesignServices@fresnocountyca.gov](mailto:DesignServices@fresnocountyca.gov); or (2) via certified mail, return receipt requested to the following address: Design Division, Department of Public Works and Planning, 2220 Tulare Street, Sixth Floor, Fresno, CA 93721.

**The bid protest must be received no later than 5:00 p.m. of the seventh (7<sup>th</sup>) calendar day following the deadline for submittal of the specific bid document(s) placed at issue by the protest.** Any Bidder filing a protest is encouraged to submit the bid protest via e-mail, because the deadline is based on the Department's receipt of the bid protest. A bid protest accordingly may be rejected as untimely if it is not received by the deadline, regardless of the date on which it was postmarked. The Bidder's compliance with the following additional procedures also is mandatory:

- a. The initial protest document shall contain a complete statement of the grounds for the protest, including a detailed statement of the factual basis and any supporting legal authority.
- b. The protest shall identify and address the specific portion of the document(s) forming the basis for the protest.
- c. The protest shall include the name, address and telephone number of the person representing the protesting party.
- d. The Department will provide a copy of the initial protest document and any attached documentation to all other Bidders or proposers who appear to have a reasonable prospect of receiving an award depending upon the outcome of the protest.
- e. The Board of Supervisors will issue a decision on the protest. If the Board of Supervisors determines that a protest is frivolous, the party originating the protest may be determined to be irresponsible and that party may be determined to be ineligible for future contract awards.
- f. The procedure and time limits set forth herein are mandatory and are the Bidder's sole and exclusive remedy in the event of a bid protest. Failure by the Bidder to comply with these procedures shall constitute a waiver of any right to further pursue the bid protest, including the subsequent filing of a Government Code Claim or legal proceedings.

### **3-1.04B AWARD PERIOD**

If the Department awards the contract, the award is made to the lowest responsible bidder within 180 calendar days after bid opening.

The Department may extend the specified award period if the Bidder agrees. You may request to extend the award period by faxing a request to Design Services before 4:00 p.m. on or before the last day of the award period. If you do not make this request, after the specified award period:

1. Your bid becomes invalid
2. You are not eligible for the award of the contract

### **3-1.05 CONTRACT BONDS (PUB CONT CODE §§ 10221 AND 10222)**

The successful bidder must furnish 2 bonds conforming to the requirements in the *Agreement* of these special provisions.

### **3-1.06 CONTRACTOR LICENSE**

For a federal-aid contract, the Contractor must be properly licensed as a contractor from contract award through Contract acceptance (Pub Cont Code § 10164).

For a non-federal-aid contract:

1. Contractor must be properly licensed as a contractor from bid opening through Contract acceptance (Bus & Prof Code § 7028.15)
2. Joint venture bidders must obtain a joint venture license before contract award (Bus & Prof Code § 7029.1)

### **3-1.07 INSURANCE POLICIES**

The successful bidder must submit copies of its insurance policies conforming to the requirements in the *Agreement* of these special provisions.

### **3-1.08 –3-1.10 RESERVED**

### **3-1.11 PAYEE DATA RECORD**

Complete and deliver to the Engineer a Payee Data Record form when requested by the Engineer.

### **3-1.12 RESERVED**

### **3-1.13 RESERVED**

### **3-1.14 CONDITIONAL AWARD**

The Owner will first make a “conditional award of contract” to the lowest responsible bidder whose proposal complies with all the requirements prescribed. Such Owner’s “conditional award of contract” is subject to, and conditioned upon, approval of such lowest responsible bidder’s proposal by the California State Water Resources Control Board (“SWRCB”), as evidenced by notice thereof by the SWRCB to the Owner. The Owner has no authority or control over, and the Owner does not assume any responsibility herein for, the SWRCB’s decision-making; the Owner may rely solely upon the SWRCB’s notice thereof to the Owner as proof of such SWRCB approval, if it is given. Such Owner’s “conditional award of contract” is not by itself the award of the contract.

### **3-1.15 AWARD APPROVAL & AWARD NOTIFICATION**

If the SWRCB provides the Owner with the SWRCB’s notice of approval of such lowest responsible bidder’s proposal, (a) the Owner’s receipt thereof satisfies the condition of the Owner’s “conditional award of contract” to the lowest responsible bidder whose proposal complies with all the requirements prescribed, and (b) the Director will provide written notice to the Chairman of the Board of Supervisor of the Owner and such lowest responsible bidder, mailed to the address shown on his or her proposal, substantially to the following effect:

- (a) the Owner received the SWRCB’s notice that the SWRCB approved such lowest responsible bidder’s proposal;
- (b) the Owner’s receipt of notice of such approval by the SWRCB satisfies the condition of the Owner’s “conditional award of contract” to the lowest responsible bidder whose proposal complies with all the requirements prescribed; and
- (c) that such written notice is given pursuant to this section.

The award of contract, if it is to be made, will be made as follows: the Director will notify the successful bidder by letter, mailed to the address shown on his or her proposal, that (a) his or her bid has been accepted and that he or she has been awarded the contract, and (b) before the Owner executes the written contract, the successful bidder must first comply with Section 03-5.01, below. The Owner shall not be required to enter into the written contract with the successful bidder unless and until the successful bidder shall have complied with Section 3-1.18, below.

The right is reserved by the Owner to reject any or all proposals, to waive technicalities, to advertise for new proposals, or to proceed to do this work otherwise, if in the judgment of the Owner the best interests of the Owner will be promoted thereby.

### **3-1.16 EXTENSION OF TIME**

If the Owner finds that it will be unable to award the contract within one hundred eighty (180) calendar days after the opening of proposals, the Director may request any or all bidders to extend all terms of their proposal(s) to a specified date. More than one such extension may be requested, and in all such instances, the provisions of this section shall likewise apply. If a bidder who receives a request for an

extension does not elect to extend the terms of his or her proposal beyond the one hundred eighty (180) calendar days (or such further extended date) following opening of proposals, or does not respond within seven (7) calendar days to a request for an extension, that bidder's proposal will be deemed as having expired, and that bidder's proposal will not be considered for award of the contract.

### **3-1.17 CANCELLATION OF CONDITIONAL AWARD OR AWARD**

The Owner reserves the right to cancel the conditional award of any contract or the award of any contract at any time before the execution of said contract by all parties without any liability against the Owner.

### **3-1.18 CONTRACT EXECUTION**

The successful bidder must sign the *Agreement*.

Deliver to Design Services:

1. Signed *Agreement*
2. Contract bonds
3. Documents identified in section 3-1.07
4. For a federal-aid contract, *Local Agency Bidder - DBE Information* form

Design Services must receive these documents before the 10th business day after the bidder receives the contract.

The bidder's security may be forfeited for failure to execute the contract within the time specified (Pub Cont Code §§ 10181, 10182, and 10183).

### **3-1.19 BIDDERS' SECURITIES**

The Department keeps the securities of the 1st, 2nd, and 3rd low bidders until the contract has been executed. The other bidders' securities, other than bidders' bonds, are returned upon determination of the 1st, 2nd, and 3rd low bidders, and their bidders' bonds are of no further effect (Pub Cont Code § 10184).

## **4 SCOPE OF WORK**

**Replace Section 4-1.02 with:**

### **4-1.02 INTENT**

The Contract intent is to provide for work completion using the best general practices.

Nothing in the specifications, special provisions, Standard Specifications, or in any other Contract document voids the Contractor's public safety responsibilities.

**Replace the paragraphs of Section 4-1.07C with the following:**

### **4-1.07C Reserved**

**Replace Section 4-1.13 with:**

### **4-1.13 CLEANUP**

Before final inspection, leave the job site neat and presentable and dispose of:

1. Rubbish
2. Excess materials
3. Falsework
4. Temporary structures
5. Equipment

Remove warning, regulatory, and guide signs when directed by the Engineer.

## **5 CONTROL OF WORK**

### **Delete the 9<sup>th</sup> Paragraph of Section 5-1.01**

#### **Add the following before the last sentence in Section 5-1.02**

Caltrans Standard Plans, City of Fresno Standard Drawings, and any other other-agency Standard Drawings included in the "Project Details" section of the book entitled "Specifications" have the same ranking as Standard Plans."

All other drawings in the "Project Details" section of the book entitled "Specifications" have the same ranking as Project Plans.

Tables and other documents in the "Project Details" section of the book entitled "Specifications" have the same ranking as Special Provisions. If a portion of a document in the Project Details section conflicts with the Special Provisions, the Special Provisions shall prevail.

#### **Replace the headings and paragraphs of section 5-1.09 with:**

##### **5-1.09 RESERVED**

#### **Replace Section 5-1.12 with:**

##### **5-1.12 ASSIGNMENT**

No third-party agreement relieves you or your surety of the responsibility to complete the work. Do not sell, transfer, or otherwise dispose of any Contract part without prior written consent from the Department.

If you assign the right to receive Contract payments, the Engineer accepts the assignment upon the Engineer's receipt of a notice. Assigned payments remain subject to deductions and withholds described in the Contract. The Department may use withheld payments for work completion whether payments are assigned or not.

A pending or disapproved request for assignment does not relieve you of the responsibility to commence and pursue work timely and in strict accordance with contract documents.

#### **Replace the headings and paragraphs of section 5-1.13C with:**

##### **5-1.13C RESERVED**

#### **Replace the headings and paragraphs of section 5-1.13D with:**

##### **5-1.13D RESERVED**

#### **Add the following paragraph to the end of section 5-1.16 with:**

**Submit Daily Log records to the Engineer weekly for the entire course of work unless the Engineer requests another interval.**

#### **Replace the paragraphs of section 5-1.20B(4) with:**

##### **5-1.20B(4) Contractor–Property Owner Agreement**

Before procuring material from or disposing or stockpiling of material on non-highway property:

1. Provide proof that the property where materials are to be stockpiled or equipment parked/stored is appropriately zoned and/or permitted for the use proposed by the Contractor.
2. Obtain written authorization from each and every owner of the property where materials are to be stockpiled or equipment parked/stored.
3. Provide proof that the signor(s) of the authorization are the owners of the property.
4. Provide an executed release from the property owner(s) absolving the Department from any and all responsibility in connection with the stockpiling of materials or parking/storage of equipment on said property.
5. Obtain written permission from the Engineer to stockpile materials or park/store equipment at the location designated in said authorization.



Before Contract acceptance, submit a document signed by the owner of the material source or disposal site stating that the Contractor has complied with the Contractor-owner agreement.

Failure by the Contractor to provide written authorization shall result in the withholding of all funds due to the Contractor until said authorization is received by the County.

**Replace the paragraph of Section 5-1.20E with:**

County Special District (the local water authority) will allow the Contractor to access water for Construction Projects. The Contractor will be required to install a meter and a backflow preventer prior to connection to the system.

Refer to Section 01 51 36 "WATER AND WATERING" of the Technical Specifications.

**Replace the paragraphs of section 5-1.23A with:**

**5-1.23A General**

Section 5-1.23 includes specifications for action and informational submittals.

Any submittal not specified as an informational submittal is an action submittal.

Submit action and informational submittals to the Engineer. Unless otherwise specified in these Specifications, submittals shall be provided via email in .pdf format.

Each submittal must have a cover sheet that must include:

1. Contract number
2. Project Name
3. Date
4. Submittals (and resubmittals if applicable) must be numbered sequentially
5. Structure number if applicable
6. Contractor
7. Person responsible for submitting the submittal
8. Signature of Contractor's representative sending submittal
9. Section number and/or item submittal is referencing
10. Pages of submittal, excluding cover sheet

The Department rejects a submittal if it has any error or omission.

If the last day for submitting a document falls on a Saturday or holiday, it may be submitted on the next business day with the same effect as if it had been submitted on the day specified.

Documents must be submitted in the English language.

Convert documents to US customary units.

**Replace Section 5-1.26 with:**

**5-1.26 CONSTRUCTION SURVEYS**

Refer to Section 01 57 50 of the Technical Specifications.

**Replace Section 5-1.27E with:**

**5-1.27E CHANGE ORDER BILLS**

Maintain separate records for change order work costs.

**5-1.32 AREAS FOR USE**

Occupy the highway only for purposes necessary to perform the work.

Defend, indemnify, and hold the Department harmless to the same extent as under section 7-1.05.

The Department does not allow temporary residences within the County right-of-way.

## **6 CONTROL OF MATERIALS**

**Replace section 6-1.04 with:**

### **6-1.04 AMERICAN IRON AND STEEL**

#### **6-1.04A General**

This project is subject to “American Iron and Steel” provisions. Unless a predominantly iron or steel product qualifies for an exemption, as listed by the United States Environmental Protection Agency, all manufactured iron and steel products must be certified as produced within the United States. Attention is directed to the “American Iron and Steel” requirements of P.L. 113-76 (also known as the Continuing Appropriations Act of 2014), and the regulations adopted pursuant thereto. In conformance with the law and regulations, all manufacturing processes for steel and iron materials furnished for incorporation into the work on this project shall occur in the United States. American Iron and Steel compliance certifications and/or waivers must be provided to the Engineer with the applicable material or equipment submittal, as specified elsewhere in these provisions, for any covered materials. A list of materials covered by this provision, as well as any active state or nationwide waivers, may be obtained for the United States Environmental Protection Agency. The Contractor acknowledges to and for the benefit of the County, the State of California, and the United States, that it understands the goods and services under this Agreement are being funded with monies made available from the DWSRF and Proposition 1 that have statutory requirements commonly known as “American Iron and Steel;” that requires all of the iron and steel products used in the project to be produced in the United States (“American Iron and Steel Requirement”) including iron and steel products provided by the Contractor for this contract. The Contractor represents and warrants to and for the benefit of the County, the State of California, and the United States, that: the Contractor has reviewed and understands the American Iron and Steel Requirement; all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved; and the Contractor will provide any further verified information, certification or assurance of compliance with this section, or information necessary to support compliance or a waiver of the American Iron and Steel Requirement, as may be requested by the County, the State of California, or the United States. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the County, the State of California, or the United States, to recover damages against the Contractor any loss, expense, or cost (including without limitation attorney’s fees) incurred by the County, the State of California, or the United States, resulting from such a failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State of California or any damages owed to the State of California by the County). While the Contractor has no direct contractual privity with the State of California, as a lender to the County for the funding of its project, the County and the Contractor agree that the State of California is a third-party beneficiary and neither this paragraph (nor any other provision of this contract necessary to give this

paragraph force or effect) shall be amended or waived without the prior written consent of the State of California.

#### **6-1.04B Iron and Steel Products**

In general, all products made primarily of iron and steel to be incorporated into the project during construction must be produced in the United States, with the exception of:

1. Raw materials, such as ores, limestone and iron and steel scrap
2. Non-iron or steel components of an iron and steel product
3. Mechanical and electrical components and equipment
4. Any item for which a waiver has been approved by the United States Environmental Protection Agency.

Attention is directed to the guidance memorandum provided by the United States Environmental Protection Agency, which has been included in the project details section.

#### **6-1.04C Certification**

Certifications or waivers must be provided for all applicable materials under the American Iron and Steel provisions, which are not covered under a waiver from the United States Environmental Protection Agency. Certifications must indicate that each material has been produced or manufactured in the United States.

**Replace section 6-1.05 with:**

#### **6-1.05 SPECIFIC BRAND OR TRADE NAME AND SUBSTITUTION**

Unless substitution is expressly precluded in the special provisions, a reference to a specific brand or trade name establishes a quality standard and is not intended to limit competition. Unless the Department has made a public interest finding expressly authorizing sole source procurement of a particular item, you may use a product that is equal to or better than the specified brand or trade name if authorized.

Submit a substitution request with a time period that:

1. Follows Contract award
2. Allows 30 days for review
3. Causes no delay

Include substantiating data with the substitution request that proves that substitution:

1. Causes no delay
2. Is of equal or better quality and suitability

If the special provisions disallow substitution of a particular item, provide the specified item and do not propose substitution.

## **7 LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC**

**Replace the 2<sup>nd</sup> Paragraph of Section 7-1.02K(2) with:**

The general prevailing wage rates and any applicable changes to these wage rates are available:

1. From Design Services
2. From the Department of Industrial Relations' Web site

**Replace section 7-1.02K(3) with:**

04-22-16

Keep accurate payroll records.

Submit a copy of your certified payroll records, weekly, including those of subcontractors. Include:

1. Each employee's:
  - 1.1. Full name
  - 1.2. Address
  - 1.3. Social security number
  - 1.4. Work classification
  - 1.5. Straight time and overtime hours worked each day and week
  - 1.6. Actual wages paid for each day to each:
    - 1.6.1. Journeyman
    - 1.6.2. Apprentice
    - 1.6.3. Worker
    - 1.6.4. Other employee you employ for the work
  - 1.7. Pay rate
  - 1.8. Itemized deductions made
  - 1.9. Check number issued
  - 1.10. Fringe Benefits
2. Apprentices and the apprentice-to-journeyman ratio

Each certified payroll record must include a Statement of Compliance form signed under penalty of perjury that declares:

1. Information contained in the payroll record is true, correct, and complete
2. Employer has complied with the requirements of sections 1771, 1811, and 1815 for any work performed by his or her employees on the public works project
3. Wage rates paid are at least those required by the Contract

Submitted certified payrolls for hauling and delivering ready-mixed concrete must be accompanied by a written time record. The time record must include:

1. Truck driver's full name and address
2. Name and address of the factory or batching plant
3. Time the concrete was loaded at the factory or batching plant
4. Time the truck returned to the factory or batching plant
5. Truck driver's signature certifying under penalty of perjury that the information contained in this written time record is true and correct

Make certified payroll records available for inspection at all reasonable hours at your main office on the following basis:

1. Upon the employee's request or upon request of the employee's authorized representative, make available for inspection a certified copy of the employee's payroll record.
2. Refer the public's requests for certified payroll records to the Department. Upon the public's request, the Department makes available for inspection or furnishes copies of your certified payroll records. Do not give the public access to the records at your main office.

Make all payroll records available for inspection and copying or furnish a copy upon request of a representative of the:

1. Department
2. Division of Labor Standards Enforcement of the Department of Industrial Relations
3. Division of Apprenticeship Standards of the Department of Industrial Relations

Furnish the Department the location of the records. Include the street address, city, and county. Furnish the Department a notification of a location and address change within 5 business days of the change.

Comply with a request for the records within 10 days after you receive a written request. If you do not comply within this period, the Department withholds from progress payments a \$100 penalty for each day or part of a day for each worker until you comply. You are not assessed this penalty for a subcontractor's failure to comply with Labor Code § 1776.

The Department withholds from progress payments for delinquent or inadequate records (Labor Code § 1771.5). If you have not submitted an adequate record by the month's 15th day for the period ending on or before the 1st of that month, the Department withholds up to 10 percent of the monthly progress estimate, exclusive of mobilization. The Department does not withhold more than \$10,000 or less than \$1,000.

#### **7-1.02K(4)i Apprenticeship Requirements for non-Federal Projects**

- A. Pursuant to Sections 1770-1780 of the Labor Code of the State of California, the Director of the Department of Industrial Relations has determined the general prevailing rate of wages in the locality for each craft or type of worker needed to execute the work. Said wage rates pursuant to Section 1773.2 of the Labor Code are on file with the Clerk to the Fresno County Board of Supervisors, and will be made available to any interested person on request. A copy of this wage scale may also be obtained at the following Web Site: [www.dir.ca.gov/dlsr](http://www.dir.ca.gov/dlsr).
- B. Pursuant to Section 1775 of the Labor Code of the State of California, nothing in this Article shall prevent the employment of properly registered apprentices upon public works. Every such apprentice shall be paid the standard wage paid to apprentices under the regulations of the craft or trade at which he/she is employed, and shall be employed only at the work of the craft or trade to which he/she is registered.
- C. Only apprentices, as defined in Section 3077, who are in training under apprenticeship standards and written apprentice agreements under Chapter 4 (commencing at Section 3070), Division 3, of the Labor Code, are eligible to be employed on public works. The employment and training of each apprentice shall be in accordance with the provisions of the apprenticeship standards and apprentice agreements under which he/she is training.
- D. Fresno County is committed to increasing the availability of employment and training opportunities, with particular attention to the plight of those who are most economically disadvantaged. In an effort to advance that purpose, the County will require that the Contractor and each subcontractor employed on this Project shall use their best efforts to ensure that thirty-three percent (33%) of apprentice hours, as determined by California Labor Code Section 1777.5 for each contractor and subcontractor of any tier on this Project, are performed by qualified participants in state approved apprenticeship programs who also are current or former "Welfare-to-Work" participants in the CalWORKs program. Provided, that nothing contained in this Paragraph D shall be interpreted to relieve or in any way diminish the obligation of the Contractor and each subcontractor to comply fully with all applicable apprenticeship laws in accordance with the California Labor Code and the California Code of Regulations; and accordingly such requirements as are contractually imposed by this Paragraph D shall be in addition to such legally mandated requirements, and applicable only to the extent fully consistent therewith.

**7-1.02K(6)(j)(ii) Lead Compliance Plan**

**Add the following at the beginning of this Section**

**Only one lead compliance plan is required for this entire project. Refer to Specification Section 01 22 00 "Explanation of Bid Items"**

**Add between the 9th and 10th paragraphs of section 7-1.03:**

07-15-16

If a height differential of more than 0.04 foot is created by construction activities at a joint transverse to the direction of traffic on the traveled way or a shoulder subject to public traffic, construct a temporary taper at the joint with a slope complying with the requirements shown in the following table:

**Temporary Tapers**

Height differential (foot)	Slope (horizontal:vertical)	
	Taper use of 14 days or less	Taper use of more than 14 days
Greater than 0.08	100:1 or flatter	200:1 or flatter
0.04–0.08	70:1 or flatter	70:1 or flatter

For a taper on existing asphalt concrete or concrete pavement, construct the taper with minor HMA under section 39-2.07.

Grind existing surfaces to accommodate a minimum taper thickness of 0.10 foot under either of the following conditions:

1. HMA material such as rubberized HMA, polymer-modified bonded wearing course, or open-graded friction course is unsuitable for raking to a maximum 0.02 foot thickness at the edge
2. Taper will be in place for more than 14 days

For a taper on a bridge deck or approach slab, construct the taper with polyester concrete under section 60-3.04B.

The completed surface of the taper must be uniform and must not vary more than 0.02 foot from the lower edge of a 12-foot straightedge when placed on its surface parallel and perpendicular to traffic.

If authorized, you may use alternative materials or methods to construct the required taper.

**Replace the headings and paragraphs of Section 7-1.04 with:**

**7-1.04 PUBLIC SAFETY**

**7-1.04A GENERAL**

You are responsible to provide for public safety.

Do not construct a temporary facility that interferes with the safe passage of traffic.

Control dust resulting from the work, inside and outside the right-of-way.

Move workers, equipment, and materials without endangering traffic.

Whenever your activities create a condition hazardous to the public, furnish, erect and maintain those fences, temporary railing, barricades, lights, signs, and other devices and take any other necessary protective measures to prevent damage or injury to the public.

Any fences, temporary railing, barricades, lights, signs, or other devices furnished, erected and maintained by you are in addition to those for which payment is provided elsewhere in the specifications.

Provide flaggers whenever necessary to ensure that the public is given safe guidance through the work zone. At locations where traffic is being routed through construction under one-way controls, move your equipment in compliance with the one-way controls unless otherwise ordered.

Use of signs, lights, flags, or other protective devices must comply with the *California MUTCD* and any directions of the Engineer. Signs, lights, flags or other protective devices must not obscure the visibility of, nor conflict in intent, meaning, and function of either existing signs, lights and traffic control devices, or any construction area signs.

Keep existing traffic signals and highway lighting in operation. Other forces within the Department will perform routine maintenance of these facilities during the work.

Cover signs that direct traffic to a closed area.

Install temporary illumination in a manner which the illumination and the illumination equipment does not interfere with public safety. The installation of general roadway illumination does not relieve you from furnishing and maintaining any protective devices.

Equipment must enter and leave the highway via existing ramps and crossovers and must move in the direction of traffic. All movements of workmen and construction equipment on or across lanes open to traffic must be performed in a manner that do not endanger the public. Your vehicles or other mobile equipment leaving an open traffic lane to enter the construction area must slow down gradually in advance of the location of the turnoff to give the traffic following an opportunity to slow down. When leaving a work area and entering a roadway carrying traffic, your vehicles and equipment must yield to traffic.

Immediately remove hauling spillage from a roadway lane or shoulder open to traffic. When hauling on roadways, trim loads and remove material from shelf areas to minimize spillage.

Notify the Engineer not less than 5 days before the anticipated start of an activity that will change the vertical or horizontal clearance available to traffic, including shoulders.

Do not store vehicles, material, or equipment in a way that:

1. Creates a hazard to the public
2. Obstructs traffic control devices

Do not install or place temporary facilities used to perform the work which interfere with the free and safe passage of traffic.

Temporary facilities that could be a hazard to public safety if improperly designed must comply with design requirements described in the Contract for those facilities or, if none are described, with standard design criteria or codes appropriate for the facility involved. Submit shop drawings and design calculations for the temporary facilities and show the standard design criteria or codes used. Shop drawings and supplemental calculations must be sealed and signed by an engineer who is registered as a civil engineer in the State.

If you appear to be neglectful or negligent in furnishing warning devices and taking protective measures, the Engineer may direct your attention to the existence of a hazard. You must furnish and install the necessary warning devices. If the Engineer points out the inadequacy of warning devices and protective measures, that action on the part of the Engineer does not relieve you from your responsibility for public safety or abrogate your obligation to furnish and pay for these devices and measures.

Install Type K temporary railing or other authorized protective systems under any of the following conditions:

1. Excavations: Where the near edge of the excavation is within 15 feet from the edge of an open traffic lane
2. Temporarily unprotected permanent obstacles: When the work includes the installation of a fixed obstacle together with a protective system, such as a sign structure together with protective railing,

and you elect to install the obstacle before installing the protective system; or you, for your convenience and as authorized, remove a portion of an existing protective railing at an obstacle and do not replace such railing completely the same day

3. Storage areas: When material or equipment is stored within 15 feet of the edge of an open traffic lane and the storage is not otherwise prohibited by the Contract
4. Height differentials: When construction operations create a height differential greater than 0.15 feet within 15 feet of the edge of traffic lane

Installation of Type K temporary railing is not required if an excavation within 15 feet from the edge of an open traffic lane is protected by any of the following:

1. Steel plate or concrete covers of adequate thickness to prevent accidental entry by traffic or the public
2. Side slope where the downhill slope is 4:1 (horizontal: vertical) or less unless a naturally occurring condition
3. Barrier or railing

Offset the approach end of Type K temporary railing a minimum of 15 feet from the edge of an open traffic lane. Install the temporary railing on a skew toward the edge of the traffic lane of not more than 1 foot transversely to 10 feet longitudinally with respect to the edge of the traffic lane. If the 15-foot minimum offset cannot be achieved, the temporary railing must be installed on the 10 to 1 skew to obtain the maximum available offset between the approach end of the railing and the edge of the traffic lane, and an array of temporary crash cushion modules must be installed at the approach end of the temporary railing.

Secure Type K temporary railing in place before starting work for which the temporary railing is required.

Where 2 or more lanes in the same direction are adjacent to the area where the work is being performed, including shoulders, the adjacent lane must be closed under any of the following conditions:

1. Work is off the traveled way but within 6 feet of the edge of the traveled way, and the approach speed is greater than 45 miles per hour
2. Work is off the traveled way but within 3 feet of the edge of the traveled way, and the approach speed is less than 45 miles per hour

Closure of the adjacent traffic lane is not required when performing any of the following:

1. Working behind a barrier
2. Paving, grinding, or grooving
3. Installing, maintaining, or removing traffic control devices except Type K temporary railing

Do not reduce an open traffic lane width to less than 10 feet. When traffic cones or delineators are used for temporary edge delineation, the side of the base of the cones or delineators nearest to traffic is considered the edge of the traveled way.

If a traffic lane is closed with channelizers for excavation work, move the devices to the adjacent edge of the traveled way when not excavating. Space the devices as specified for the lane closure.

Do not move or temporarily suspend anything over a traffic lane open to the public unless the public is protected.

## **7-1.04B WORK ZONE SAFETY AND MOBILITY**

### **7-1.04B(1) POLICY**

In order to ensure safe and efficient flow of traffic through work zones, the County of Fresno, via its General Plan, Transportation and Circulation Element, Policy TRA-1, has adopted the use of AASHTO Standards as supplemented by Caltrans and County Department of Public Works and Planning Standards.



#### **7-1.04B(2)TRAFFIC MANAGEMENT PLAN**

Perform traffic management shall be in accordance with Section 12, "TEMPORARY TRAFFIC CONTROL," of these special provisions.

#### **7-1.04B(3)TEMPORARY TRAFFIC CONTROL PLAN**

Prepare traffic control plan(s) in accordance with Section 12, "TEMPORARY TRAFFIC CONTROL," of these special provisions.

#### **7-1.04B(4)PUBLIC INFORMATION**

Provide notice to public agencies and others to the extent required, if any, elsewhere in these special provisions. The Engineer provides other noticing not identified to be performed by the Contractor.

**Replace the headings and paragraphs of Section 7-1.06 with:**

#### **7-1.06 INSURANCE**

##### **7-1.06A General**

Nothing in the Contract is intended to establish a standard of care owed to any member of the public or to extend to the public the status of a third-party beneficiary for any of these insurance specifications.

##### **7-1.06B Casualty Insurance**

Obtain and maintain insurance on all of your operations with companies acceptable to the Department as follows:

1. Keep all insurance in full force and effect from the start of the work through Contract acceptance.
2. All insurance must be with an insurance company with a rating from A.M. Best Financial Strength Rating of A or better and a Financial Size Category of VIII or better.
3. Maintain completed operations coverage with a carrier acceptable to the State through the expiration of the patent deficiency in construction statute of repose set forth in Civ Pro Code § 337.1.

##### **7-1.06C Workers' Compensation and Employer's Liability Insurance**

Under Labor Code § 1860, secure the payment of worker's compensation under Labor Code § 3700.

Submit to the Department the following certification before performing the work (Labor Code § 1861):

I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this contract.

Contract signing constitutes certification submittal.

Provide Employer's Liability Insurance in amounts not less than:

1. \$1,000,000 for each accident for bodily injury by accident
2. \$1,000,000 policy limit for bodily injury by disease
3. \$1,000,000 for each employee for bodily injury by disease

If there is an exposure of injury to your employees under the U.S. Longshoremen's and Harbor Workers' Compensation Act, the Jones Act, or under laws, regulations, or statutes applicable to maritime employees, coverage must be included for such injuries or claims.

## **7-1.06D Liability Insurance**

### **7-1.06D(1) General**

Carry General Liability and Umbrella or Excess Liability Insurance covering all operations by or on behalf of you providing insurance for bodily injury liability and property damage liability for the following limits and including coverage for:

1. Premises, operations and mobile equipment
2. Products and completed operations
3. Broad form property damage (including completed operations)
4. Explosion, collapse, and underground hazards
5. Personal injury
6. Contractual liability

### **7-1.06D(2) Liability Limits/Additional Insureds**

Refer to the *Agreement* of these special provisions

Additional insured coverage must be provided by a policy provision or by an endorsement providing coverage at least as broad as *Additional Insured* (Form B) endorsement form CG 2010, as published by the Insurance Services Office (ISO), or other form designated by the Department.

### **7-1.06D(3) Contractor's Insurance Policy is Primary**

The policy must stipulate that the insurance afforded the additional insureds applies as primary insurance. Any other insurance or self-insurance maintained by the State is excess only and must not be called upon to contribute with this insurance.

## **7-1.06E Automobile Liability Insurance**

Comply with requirements in the *Agreement* of these special provisions

### **7-1.06F Policy Forms, Endorsements, and Certificates**

Provide your General Liability Insurance under Commercial General Liability policy form no. CG0001 as published by the Insurance Services Office (ISO) or under a policy form at least as broad as policy form no. CG0001.

### **7-1.06G NOT USED**

### **7-1.06H Enforcement**

The Department may assure your compliance with your insurance obligations. Ten days before an insurance policy lapses or is canceled during the Contract period you must submit to the Department evidence of renewal or replacement of the policy.

If you fail to maintain any required insurance coverage, the Department may maintain this coverage and withhold or charge the expense to you or terminate your control of the work.

You are not relieved of your duties and responsibilities to indemnify, defend, and hold harmless the State, its officers, agents, and employees by the Department's acceptance of insurance policies and certificates.

Minimum insurance coverage amounts do not relieve you for liability in excess of such coverage, nor do they preclude the State from taking other actions available to it, including the withholding of funds under this Contract.

### **7-1.06I Self-Insurance**

Comply with the *Agreement* of these special provisions

**Replace the headings and paragraphs of Section 7-1.07 with:**

### **7-1.07 LEGAL ACTIONS AGAINST THE DEPARTMENT**

#### **7-1.07A General**

If legal action is brought against the Department over compliance with a State or federal law, rule, or regulation applicable to highway work, then:

1. If the Department in complying with a court order prohibits you from performing work, the resulting delay is a suspension related to your performance, unless the Department terminates the Contract.
2. If a court order other than an order to show cause or the final judgment in the action prohibits the Department from requiring you to perform work, the Department may delete the prohibited work or terminate the Contract.

#### **7-1.07B Seal Coat Claims**

RESERVED

#### **7-1.07C Claims**

This section applies to non-seal coat projects which involve asphalt concrete paving. Pay for claims for personal property damage caused by your work. Claims are limited to:

1. 10 percent of the total bid

Within 30 days of the last working day placement of hot mix asphalt, do the following:

1. Process and resolve all claims reported or submitted to you by the public as follows:
  - 1.1. Within 3 business days of receipt of a claim, submit to the Department a copy of the claim, a written analysis of the claim, and a statement indicating whether or not you will pay the claim. If you reject a claim, provide the reasons for rejection in writing.
  - 1.2. If the claimant becomes dissatisfied with your handling of the claim, immediately refer the claimant to the local district claims office for assistance in resolving the claim.
2. Submit to the Department evidence of your paid claims.

All claims presented to the Department, (Govt Code § 900 et seq.) are processed and resolved by the Department as follows:

1. The claims are processed as formal government claims subject to all laws and policies and are resolved as the Department determines including referring the claim to you for handling.
2. If the Department approves settlement of a claim or is ordered to pay pursuant to a court order, the claim is paid from funds withheld from you.
3. Within 3 business days of the Department's determination that you are responsible for resolving the claim, the Department sends a copy of the claim to you for resolution or notifies you of the Department's decision to resolve the claim.

The Department withholds an amount not to exceed 5 percent of the total bid to resolve all claims. The amount is held no longer than 60 days following the last working day so that the Department has ample time to resolve any pending claims. After 60 days, any remaining amount withheld is returned to you.

If no withheld funds remain or have been returned, the Department may pay any claims and seek reimbursement from you through an offset or any other legal means. Any reimbursement or offset to be recovered from you, including all other paid claims, is limited to 10 percent of the total bid.

Section 7-1.07C does not limit your obligation to defend and indemnify the Department.

**Add between the 1st and 2nd paragraphs of Section 7-1.11A:**

Comply with 46 CFR 381.7(a)–(b).

**Add to the end of Section 7-1.11B**

Comply with the Davis-Bacon Requirements for DWSRF Projects included in the Project Details section.

**Add the following Section 7-1.11D**

**7-1.11D Procurement Prohibitions from Excluded Parties**

No goods, services, or materials shall be procured from suppliers excluded under the federal System for Award Management, except where the purpose of is to remedy the cause of the violation. Excluded parties may be identified at <http://SAM.gov>. This clause is pursuant to Section 306 of the Clean Air Act and Section 508 of the Clean Water Act, including Executive Order 11738, Administration of the Clean Air Act and Federal Water Pollution Control Act with Respect to Federal Contracts, Grants, or Loans; 42 USC 7606; 33 USC 1368.

**8 PROSECUTION AND PROGRESS**

**Replace the headings and paragraphs in Section 8 with:**

**8-1.01 GENERAL**

Section 8 includes specifications related to prosecuting the Contract and work progress.

**8-1.01A Work Hours**

Perform all work on working days during daytime.

Plan work so that all construction operations performed each day, including cleanup of the project site, establishment of appropriate traffic control and any other work necessary for the safety of the public shall be completed within the daytime hours.

Do not perform work during nighttime unless approved by the Engineer

Request approval to work during nighttime in writing and include the appropriate traffic control plan(s) and work plan(s) which clearly identify all provisions for illuminating all portions of the work site, including any flagging operations.

If you work fail to complete work during the daytime hours, the Engineer may stop all work upon the onset of nighttime and order you to perform any and all work the Engineer deems necessary to ensure the safety of the public during the nighttime hours.

You are not entitled to any additional compensation or extension of the contract time as a result of the Engineer stopping the work due to the onset of nighttime.

**8-1.02 SCHEDULE**

**8-1.02A General**

Upon completion of all work, the Department returns the withholds associated with section 8-1.02 and makes a payment adjustment for work not performed in the same manner as work-character changes.

**8-1.02B Level 1 Critical Path Method Schedule**

**8-1.02B(1) General**

No pay item is provided for Level 1 Critical Path Project Schedule. Payment is considered to be included in the various items of work.

Before or at the preconstruction conference, submit a CPM baseline schedule.

For each schedule, submit:

1. Plotted original, time-scaled network diagram on a sheet at least 8-1/2 by 11 inches with a title block and timeline
2. Read-only compact disc or other Engineer-authorized data-storage device containing the schedule data if software is used to make the schedule. Label the device with:
  - 2.1. Contract number
  - 2.2. CPM schedule number and date produced
  - 2.3. File name

### **8-1.02B(2) Schedule Format**

On each schedule, show:

1. Planned and actual start and completion dates of each work activity, including applicable:
  - 1.1. Submittal development
  - 1.2. Submittal review and acceptance
  - 1.3. Material procurement
  - 1.4. Contract milestones and constraints
  - 1.5. Equipment and plant setup
  - 1.6. Interfaces with outside entities
  - 1.7. Erection and removal of falsework and shoring
  - 1.8. Test periods
  - 1.9. Major traffic stage change
  - 1.10. Final cleanup
2. Order that you propose to prosecute the work
3. Logical links between the time-scaled work activities
4. All controlling activities
5. Legible description of each activity
6. At least 1 predecessor and 1 successor to each activity except for project start and project end milestones
7. Duration of at least 1 working day for each activity
8. Start milestone date as the Contract approval date

### **8-1.02B(3) Updated Schedule**

Submit a monthly updated schedule that includes the status of work completed to date and the work yet to be performed as planned.

You may include changes to updated schedules that do not alter a critical path or extend the scheduled completion date compared to the current schedule. Changes may include:

1. Adding or deleting activities
2. Changing activity constraints
3. Changing durations
4. Changing logic

If any proposed change in planned work would alter the critical path or extend the scheduled completion date, submit a revised schedule within 15 days of the proposed change.

### **8-1.02C–8-1.02F Reserved**

### **8-1.03 PRECONSTRUCTION CONFERENCE**

Attend a preconstruction conference with key personnel, including your assigned representative, at a time and location determined by the Engineer. Submit documents as required before the preconstruction conference.

Be prepared to discuss the topics and documents shown in the following table:

Topic	Document
Potential claim and dispute resolution	Potential claim forms
Contractor's representation	Assignment of Contractor's representative
DBE	Final utilization reports
Equipment	Equipment list
Labor compliance and equal employment opportunity	Job site posters and benefit and payroll reports
Material inspection	Notice of Materials to be Used form
Materials on hand	Request for Payment for Materials on Hand form
Measurements	--
Partnering	--
Quality control	QC plans
Safety	Injury and Illness Prevention Program and job site posters
Schedule	Baseline schedule and Weekly Statement of Working Days form
Subcontracting	Subcontracting Request form
Surveying	Survey Request form
Traffic control	Traffic contingency plan and traffic control plans
Utility work	--
Weight limitations	--
Water pollution control	SWPPP or WPCP
Work restrictions	PLACs
Action submittals	--

#### **8-1.04 START OF JOB SITE ACTIVITIES**

##### **8-1.04A General**

Provide signed contracts, bonds, and evidence of insurance timely as required.

This section, 8-1.04, "Start of Job Activities," does not modify remedies available to the Department should you fail to provide signed contracts bonds and insurance timely.

Submit a notice 72 hours before starting job site activities. If the project has more than 1 location of work, submit a separate notice for each location.

You may start job site activities before receiving notice of Contract approval if you:

1. Deliver the signed Contract, bonds, and evidence of insurance to the Department
2. Submit 72-hour notice
3. Obtain an encroachment permit from the Department
4. Are authorized by the Department to start
5. Perform work at your own risk
6. Perform work under the Contract

If the Contract is approved, work already performed that complies with the Contract is authorized.

If the Contract is not approved, leave the job site in a neat condition. If a facility has been changed, restore it to its former condition or an equivalent condition. The Department does not pay for the restoration.

**Replace Section 8-1.04B with:**

**8-1.04B Reserved**

**Replace Section 8-1.04C with:**

**8-1.04C Long Lead Time Equipment Start**

Section 8-1.04B, Standard Start, does not apply to this project.

This project includes two, non-concurrent phases.

The first order of work (submittals) involves submittals and equipment procurement.

The second order of work involves physical construction upon the project site.

**8-1.04C(1) First Order of Work, Submittals**

Be prepared to begin the first order of work no later than the 20th business day after award of the Contract by the Department.

The Engineer may issue a notice to proceed with the first order of work as soon as the Contracts, including bonds and insurance certificates, have been approved.

Start the first order of work on the day shown in the notice to proceed, unless an early start has been approved.

The Engineer may issue a notice of commencement of contract time for the first order of work if you fail to provide Contracts, including bonds and insurance certificates or other required documents timely.

The Engineer shall have a maximum of ten (10) working days in which to review and approve or reject each submittal from the Contractor. In the event that the Engineer rejects any of the Contractor's initial submittals, the Engineer shall have a maximum of ten (10) working days in which to review and approve or reject each re-submittal from the Contractor. The ten (10) working day time period for the Engineer's review shall commence on the day upon which the Engineer receives the submittal or re-submittal in question.

In the event that the Engineer's review of a submittal or re-submittal requires in excess of ten (10) working days, the Engineer shall extend the number of working days allowed for the completion of the first order of work by one working day for each working day of delay in the Engineer's completion of the review.

The first order of work is complete when you:

- have completed potholing at the project site.
- have completed a staging plan clearly depicting all phases of the work.
- have received approval for all submittals required for the project.
- have furnished a statement from the vendors that the orders for required equipment and materials have been received and accepted by said vendor.
- have furnished a statement from vendors which indicates that the anticipated delivery date for the equipment and materials ordered is in conformance with contract requirements.
- Receive a written statement that the first order of work is complete.

**Complete the first order of work before the expiration of**

**FIFTY (50) WORKING DAYS**

from the date shown in said Notice to Proceed, or in the Notice of Commencement of Contract Time, whichever was issued first.

**Pay to the County of Fresno the sum of**

**TWO THOUSAND DOLLARS (\$2,000.00)**

per day for each and every calendar day's delay in finishing the first order of work in excess of the number of working days prescribed above.

#### **8-1.04C(2) Second Order of Work**

The Engineer, in their sole discretion, may issue the Notice to Proceed – Second Order of Work immediately upon delivery to the Contractor of the materials and equipment necessary to construct the project. Alternatively, the Engineer may defer issuance of the Notice to Proceed – Second Order of Work to the extent the Engineer, in their sole discretion, deems appropriate.

Begin work at the site on the date shown on the Notice to Proceed – Second Order of Work. Do not begin site work prior to the date shown on the Notice to Proceed – Second Order of Work. The date shown on the Notice to Proceed – Second Order of Work will be the first working day charged against the allotted number of working days for the second order of work.

#### **Complete the second order of work before the expiration of ONE HUNDRED TWENTY (120) WORKING DAYS**

from the date shown in said Notice to Proceed – Second Order of Work.

Complete all work, including corrective work and punch list work, prior to the expiration of the allotted working days. Working days continue to accrue until corrective work and punch list work is completed and accepted.

#### **Pay to the County of Fresno the sum of THREE THOUSAND FIVE HUNDRED DOLLARS (\$3,500.00)**

per day for each and every calendar day's delay in finishing the second order of work, including corrective work and punch list work, in excess of the number of working days prescribed above.

Such payment is in addition to payment, if any, for failure to complete the first order of work as specified.

#### **8-1.05 TIME**

Contract time starts on the day specified in the notice to proceed or in the notice of commencement of contract time as described in section 8-1.04 or on the day you start job site activities, whichever occurs first.

Complete the work within the Contract time.

Meet each specified interim work completion date.

The Engineer issues a *Weekly Statement of Working Days* by the end of the following week.

The *Weekly Statement of Working Days* shows:

1. Working days and non-working days during the reporting week
2. Time adjustments
3. Work completion date computations, including working days remaining
4. Controlling activities

#### **8-1.06 SUSPENSIONS**

The Engineer may suspend work wholly or in part due to conditions unsuitable for work progress. Provide for public safety and a smooth and unobstructed passageway through the work zone during the suspension as specified in sections 7-1.03 and 7-1.04. Providing the passageway is force account work. The Department makes a time adjustment for the suspension due to a critical delay.

The Engineer may suspend work wholly or in part due to your failure to (1) fulfill the Engineer's orders, (2) fulfill a Contract part, or (3) perform weather-dependent work when conditions are favorable so that



weather-related unsuitable conditions are avoided or do not occur. The Department may provide for a smooth and unobstructed passageway through the work during the suspension and deduct the cost from payments. The Department does not make a time adjustment for the suspension.

Upon the Engineer's order of suspension, suspend work immediately. Resume work when ordered.

### **8-1.07 DELAYS**

#### **8-1.07A General**

To request a delay-related time or payment adjustment, submit an RFI.

#### **8-1.07B Time Adjustments**

The Department may make a time adjustment for a critical delay. The Engineer uses information from the schedule to evaluate requests for time adjustments.

To request an adjustment, submit a revised schedule showing the delay's effect on the controlling activity. If the delay has:

1. Occurred, submit records of the dates and what work was performed during the delayed activity
2. Not occurred, submit the expected dates or duration of the delayed activity

Update the schedule to the last working day before the start of the delay if ordered.

#### **8-1.07C Payment Adjustments**

The Department may make a payment adjustment for an excusable delay that affects your costs.

Only losses for idle equipment, idle workers, and moving or transporting equipment are eligible for delay-related payment adjustments.

The Engineer determines payment for idle time of equipment in the same manner as determinations are made for equipment used in the performance of force account work under section 9-1.04 with the following exceptions:

1. Delay factor in the *Labor Surcharge and Equipment Rental Rates* applies to each equipment rental rate.
2. Daily number of payable hours equals the normal working hours during the delay, not to exceed 8 hours per day.
3. Delay days exclude non-working days.
4. Markups are not added.

The Engineer determines payment adjustment for the idle workers under section 9-1.04B, but does not add markups.

The Engineer includes costs due to necessary extra moving or transporting of equipment.

The Department does not make a payment adjustment for overhead incurred during non-working days of additional construction seasons experienced because of delay.

### **8-1.08–8-1.09 RESERVED**

#### **8-1.10 LIQUIDATED DAMAGES**

##### **8-1.10A General**

The Department specifies liquidated damages (Pub Cont Code § 10226). Liquidated damages, if any, accrue starting on the 1st day after the expiration of the working days through the day of Contract acceptance except as specified in sections 8-1.10B and 8-1.10C.

The Department withholds liquidated damages before the accrual date if the anticipated liquidated damages may exceed the value of the remaining work.

Liquidated damages are specified in section 8-1.04.

### **8-1.10B Failure to Complete Work Parts within Specified Times**

The Department may deduct specified damages from payments for each day needed to complete a work part in excess of the time specified for completing the work part.

Damages for untimely completion of work parts may not be equal to the daily amount specified as liquidated damages for the project as a whole, but the Department does not simultaneously assess damages for untimely completion of work parts and for the whole work.

Damages accrue starting the 1st day after a work part exceeds the specified time through the day the specified work part is complete.

### **8-1.10C Failure to Complete Work Parts by Specified Dates**

The Department may deduct specified damages from payments for each day needed to complete a work part in excess of the specified completion date for the work part.

Damages for untimely completion of a work part may not be equal to the daily amount specified as liquidated damages for the project as a whole, but the Department does not simultaneously assess damages for untimely completion of a work part and the whole work.

Damages accrue starting the 1st day after an unmet completion date through the day the work part is complete.

### **8-1.10D RESERVED**

### **8-1.11–8-1.12 RESERVED**

### **8-1.13 CONTRACTOR'S CONTROL TERMINATION**

The Department may terminate your control of the work for failure to do any of the following (Pub Cont Code § 10253):

1. Supply an adequate workforce
2. Supply material as described
3. Pay subcontractors (Pub Cont Code §10262)
4. Prosecute the work as described in the Contract

The Department may also terminate your control for failure to maintain insurance coverage.

For a federal-aid project, the Department may terminate your control of the work for failure to include "Required Contract Provisions, Federal-Aid Construction Contracts" in subcontracts.

The Department gives notice to you and your surety at least 5 business days before terminating control. The notice describes the failures and the time allowed to remedy the failures. If failures are not remedied within the time provided, the Department takes control of the work.

The Department may complete the work if the Department terminates the Contractor's control or you abandon the project (Pub Cont Code § 10255). The Department determines the unpaid balance under Pub Cont Code § 10258 and the Contract.

At any time before final payment of all claims, the Department may convert a Contractor's control termination to a Contract termination.

### **8-1.14 CONTRACT TERMINATION**

#### **8-1.14A General**

The Director may terminate the Contract if it serves the State's best interest. The Department issues you a written notice, implements the termination, and pays you.

#### **8-1.14B Relief from Responsibility for Work**

Upon receiving a termination notice:

1. Stop work

2. Notify subcontractors and suppliers of the Contract termination and stop Contract-related work
3. Perform the Engineer-ordered work to secure the job site for termination
4. Remove equipment
5. Subject to the Engineer's authorization, settle termination-related claims and liabilities involving subcontractors and suppliers; assign to the Department the rights, titles, or interests held by you with respect to these parties

#### **8-1.14C Responsibility for Materials**

Upon receiving a termination notice, protect unused material until:

1. You submit an inventory of materials already produced, purchased, or ordered but not yet used; include the location of the material.
2. The Engineer identifies materials that will be retained by the Department. Submit bills of sales or other records of material title.
3. The Engineer confirms that unused materials paid by progress payment and materials furnished by the State have been delivered and stored as ordered.
4. The titles are transferred for materials purchased by the Department.

Dispose of materials that will not be retained by the Department.

#### **8-1.14D Contract Acceptance after Termination**

The Engineer recommends Contract acceptance after determining the completion of:

1. Work ordered to be completed before termination
2. Other work ordered to secure the project before termination
3. Material delivery and title transfer

The Department pays you under section 9-1.17.

#### **8-1.14E Payment Adjustment for Termination**

If the Department issues a termination notice, the Engineer determines the payment for termination based on the following:

1. Direct cost for the work:
  - 1.1. Including:
    - 1.1.1. Mobilization.
    - 1.1.2. Demobilization.
    - 1.1.3. Securing the job site for termination.
    - 1.1.4. Losses from the sale of materials.
  - 1.2. Not including:
    - 1.2.1. Cost of materials you keep.
    - 1.2.2. Profit realized from the sale of materials.
    - 1.2.3. Cost of material damaged by:
      - 1.2.3.1. Act of God.
      - 1.2.3.2. Act of a public enemy.
      - 1.2.3.3. Fire.
      - 1.2.3.4. Flood.
      - 1.2.3.5. Governor-declared state of emergency.
      - 1.2.3.6. Landslide.
      - 1.2.3.7. Tsunami.
    - 1.2.4. Other credits.
2. Cost of remedial work, as estimated by the Engineer, is not reimbursed.
3. Allowance for profit not to exceed 4 percent of the cost of the work. Prove a likelihood of having made a profit had the Contract not been terminated.
4. Material handling costs for material returned to the vendor or disposed of as ordered.
5. Costs in determining the payment adjustment due to the termination, excluding attorney fees and litigation costs.

Termination of the Contract does not relieve the surety of its obligation for any just claims arising out of the work performed.

**8-1.15–8-1.16 RESERVED**

## **9 PAYMENT**

**Add the following Section 9-1.01A**

### **9-1.01A COMPENSATION**

The bid items shown in the bid proposal sheet represent full compensation for performing all work. Full compensation for any work for which there is no bid item shall be considered to be included in the various items of work.

**Replace the headings and paragraphs of Section 9-1.03 with:**

### **9-1.03 PAYMENT SCOPE**

The Department pays you for furnishing the resources and activities required to complete the work. The Department's payment is full compensation for furnishing the resources and activities, including:

1. Risk, loss, damage repair, or cost of whatever character arising from or relating to the work and performance of the work
2. PLACs and taxes
3. Any royalties and costs arising from patents, trademarks, and copyrights involved in the work

The Department does not pay for your loss, damage, repair, or extra costs of whatever character arising from or relating to the work that is a direct or indirect result of your choice of construction methods, materials, equipment, or manpower, unless specifically mandated by the Contract.

Payment is:

1. Full compensation for all work involved in each bid item shown on the Bid Item List by the unit of measure shown for that bid item
2. For the price bid for each bid item shown on the Bid Item List or as changed by change order with a specified price adjustment

Full compensation for work specified in divisions I, II, and X is included in the payment for the bid items unless:

1. Bid item for the work is shown on the Bid Item List
2. Work is specified as change order work

Work paid for under one bid item is not paid for under any other bid item.

Payment for a bid item includes payment for work in sections referenced by the section set forth by that bid item.

**Notwithstanding anything to the contrary in these special provisions, full compensation for performing all work as shown, as specified, and as directed by the Engineer is considered to be included in the various bid items, and no additional payment will be made, except pursuant to a contract change order to perform work not shown and/or specified.**

**If one or more bid item(s) is/are not included, perform the work as shown and as specified and payment therefor is considered to be included in the various items of work.**

If an alternative is described in the Contract, the Department pays based on the bid items for the details and specifications not described as an alternative unless the bid item is described as an alternative, in which case, the Department pays based on the details and specifications for that alternative.

The Department pays for change order work based on one or a combination of the following:

1. Bid item prices
2. Force account
3. Agreed price
4. Specialist billing

If the Engineer chooses to pay for change order work based on an agreed price, but you and the Engineer cannot agree on the price, the Department pays by force account.

If a portion of extra work is covered by bid items, the Department pays for this work as changed quantities in those items. The Department pays for the remaining portion of the extra work by force account or agreed price.

If the amount of a deduction or withhold exceeds final payment, the Department invoices you for the difference, to be paid upon receipt.

Pay your subcontractors within 10 days of receipt of each progress payment under Pub Cont Code §§ 10262 and 10262.5.

**Replace Section 9-1.16F with:**

**9-1.16F Retentions**

The Department, once in each month, shall cause an estimate in writing to be made by the Engineer. The estimate shall include the total amount of work done and acceptable materials furnished, provided the acceptable materials are listed as eligible for partial payment as materials in the special provisions and are furnished and delivered by the Contractor on the ground and not used or are furnished and stored for use on the contract, if the storage is within the State of California and the Contractor furnishes evidence satisfactory to the Engineer that the materials are stored subject to or under the control of the Department, to the time of the estimate, and the value thereof. The estimate shall also include any amounts payable for mobilization. Daily extra work reports furnished by the Contractor less than 5 calendar days, not including Saturdays, Sundays and legal holidays, before the preparation of the monthly progress estimate shall not be eligible for payment until the following month's estimate.

The amount of any material to be considered in making an estimate will in no case exceed the amount thereof which has been reported by the Contractor to the Engineer on State-furnished forms properly filled out and executed, including accompanying documentation as therein required, less the amount of the material incorporated in the work to the time of the estimate. Only materials to be incorporated in the work will be considered. The estimated value of the material established by the Engineer will in no case exceed the contract price for the item of work for which the material is furnished.

The Department shall retain 5 percent of the estimated value of the work done and 5 percent of the value of materials so estimated to have been furnished and delivered and unused or furnished and stored as aforesaid as part security for the fulfillment of the contract by the Contractor. The Department will not hold retention for mobilization or demobilization.

The Department shall pay monthly to the Contractor, while carrying on the work, the balance not retained, as aforesaid, after deducting therefrom all previous payments and all sums to be kept or retained under the provisions of the contract. No monthly estimate or payment shall be required to be made when, in the judgment of the Engineer, the work is not proceeding in accordance with the provisions of the contract.

No monthly estimate or payment shall be construed to be an acceptance of any defective work or improper materials.

Attention is directed to the prohibitions and penalties pertaining to unlicensed contractors as provided in Business and Professions Code Sections 7028.15(a) and 7031.

**Add the following Section 9-1.23:**

### **9-1.23 RESOLUTION OF CONTRACT CLAIMS**

Public works contract claims of three hundred seventy-five thousand dollars (\$375,000) or less which arise between a Contractor and a local public agency shall be resolved in accordance with the provisions of California Public Contract Code Sections 20104-20104.6, inclusive. In addition, California Public Contract Code Section 9204 requires that the procedure established therein shall apply to all claims (as therein defined) filed by a contractor in connection with a public works project. Accordingly, this contract expressly incorporates all of the terms and conditions of those statutory provisions, which are as follows:

#### **California Public Contract Code Section 9204**

(a) The Legislature finds and declares that it is in the best interests of the state and its citizens to ensure that all construction business performed on a public works project in the state that is complete and not in dispute is paid in full and in a timely manner.

(b) Notwithstanding any other law, including, but not limited to, Article 7.1 (commencing with Section 10240) of Chapter 1 of Part 2, Chapter 10 (commencing with Section 19100) of Part 2, and Article 1.5 (commencing with Section 20104) of Chapter 1 of Part 3, this section shall apply to any claim by a contractor in connection with a public works project.

(c) For purposes of this section:

(1) "Claim" means a separate demand by a contractor sent by registered mail or certified mail with return receipt requested, for one or more of the following:

(A) A time extension, including, without limitation, for relief from damages or penalties for delay assessed by a public entity under a contract for a public works project.

(B) Payment by the public entity of money or damages arising from work done by, or on behalf of, the contractor pursuant to the contract for a public works project and payment for which is not otherwise expressly provided or to which the claimant is not otherwise entitled.

(C) Payment of an amount that is disputed by the public entity.

(2) "Contractor" means any type of contractor within the meaning of Chapter 9 (commencing with Section 7000) of Division 3 of the Business and Professions Code who has entered into a direct contract with a public entity for a public works project.

(3)(A) "Public entity" means, without limitation, except as provided in subparagraph (B), a state agency, department, office, division, bureau, board, or commission, the California State University, the University of California, a city, including a charter city, county, including a charter county, city and county, including a charter city and county, district, special district, public authority, political subdivision, public corporation, or nonprofit transit corporation wholly owned by a public agency and formed to carry out the purposes of the public agency.

(B) "Public entity" shall not include the following:

(i) The Department of Water Resources as to any project under the jurisdiction of that department.

(ii) The Department of Transportation as to any project under the jurisdiction of that department.

(iii) The Department of Parks and Recreation as to any project under the jurisdiction of that department.

(iv) The Department of Corrections and Rehabilitation with respect to any project under its jurisdiction pursuant to Chapter 11 (commencing with Section 7000) of Title 7 of Part 3 of the Penal Code.

(v) The Military Department as to any project under the jurisdiction of that department.

(vi) The Department of General Services as to all other projects.

(vii) The High-Speed Rail Authority.

(4) "Public works project" means the erection, construction, alteration, repair, or improvement of any public structure, building, road, or other public improvement of any kind.

(5) "Subcontractor" means any type of contractor within the meaning of Chapter 9 (commencing with Section 7000) of Division 3 of the Business and Professions Code who either is in direct contract with a contractor or is a lower tier subcontractor.

(d) (1) (A) Upon receipt of a claim pursuant to this section, the public entity to which the claim applies shall conduct a reasonable review of the claim and, within a period not to exceed 45 days, shall provide the claimant a written statement identifying what portion of the claim is disputed and what portion is undisputed. Upon receipt of a claim, a public entity and a contractor may, by mutual agreement, extend the time period provided in this subdivision.

(B) The claimant shall furnish reasonable documentation to support the claim.

(C) If the public entity needs approval from its governing body to provide the claimant a written statement identifying the disputed portion and the undisputed portion of the claim, and the governing body does not meet within the 45 days or within the mutually agreed to extension of time following receipt of a claim sent by registered mail or certified mail, return receipt requested, the public entity shall have up to three days following the next duly publicly noticed meeting of the governing body after the 45-day period, or extension, expires to provide the claimant a written statement identifying the disputed portion and the undisputed portion.

(D) Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the public entity issues its written statement. If the public entity fails to issue a written statement, paragraph (3) shall apply.

(2) (A) If the claimant disputes the public entity's written response, or if the public entity fails to respond to a claim issued pursuant to this section within the time prescribed, the claimant may demand in writing an informal conference to meet and confer for settlement of the issues in dispute. Upon receipt of a demand in writing sent by registered mail or certified mail, return receipt requested, the public entity shall schedule a meet and confer conference within 30 days for settlement of the dispute.

(B) Within 10 business days following the conclusion of the meet and confer conference, if the claim or any portion of the claim remains in dispute, the public entity shall provide the claimant a written statement identifying the portion of the claim that remains in dispute and the portion that is undisputed. Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the public entity issues its written statement. Any disputed portion of the claim, as identified by the contractor in writing, shall be submitted to nonbinding mediation, with the public entity and the claimant sharing the associated costs equally. The public entity and claimant shall mutually agree to a mediator within 10 business days after the disputed portion of the claim has been identified in writing. If the parties cannot agree upon a mediator, each party shall select a mediator and those mediators shall select a qualified neutral third party to mediate with regard to the disputed portion of the claim. Each party shall bear the fees and costs charged by its respective mediator in connection with the selection of the neutral mediator. If mediation is unsuccessful, the parts of the claim remaining in dispute shall be subject to applicable procedures outside this section.

(C) For purposes of this section, mediation includes any nonbinding process, including, but not limited to, neutral evaluation or a dispute review board, in which an independent third party or board assists the parties in dispute resolution through negotiation or by issuance of an evaluation. Any mediation utilized shall conform to the timeframes in this section.

(D) Unless otherwise agreed to by the public entity and the contractor in writing, the mediation conducted pursuant to this section shall excuse any further obligation under Section 20104.4 to mediate after litigation has been commenced.

(E) This section does not preclude a public entity from requiring arbitration of disputes under private arbitration or the Public Works Contract Arbitration Program, if mediation under this section does not resolve the parties' dispute.

(3) Failure by the public entity to respond to a claim from a contractor within the time periods described in this subdivision or to otherwise meet the time requirements of this section shall result in the claim being deemed rejected in its entirety. A claim that is denied by reason of the public entity's failure to have responded to a claim, or its failure to otherwise meet the time requirements of this section, shall not constitute an adverse finding with regard to the merits of the claim or the responsibility or qualifications of the claimant.

(4) Amounts not paid in a timely manner as required by this section shall bear interest at 7 percent per annum.

(5) If a subcontractor or a lower tier subcontractor lacks legal standing to assert a claim against a public entity because privity of contract does not exist, the contractor may present to the public entity a claim on behalf of a subcontractor or lower tier subcontractor. A subcontractor may request in writing, either on his or her own behalf or on behalf of a lower tier subcontractor, that the contractor present a claim for work which was performed by the subcontractor or by a lower tier subcontractor on behalf of the subcontractor. The subcontractor requesting that the claim be presented to the public entity shall furnish reasonable documentation to support the claim. Within 45 days of receipt of this written request, the contractor shall notify the subcontractor in writing as to whether the contractor presented the claim to the public entity and, if the original contractor did not present the claim, provide the subcontractor with a statement of the reasons for not having done so.

(e) The text of this section or a summary of it shall be set forth in the plans or specifications for any public works project that may give rise to a claim under this section.

(f) A waiver of the rights granted by this section is void and contrary to public policy, provided, however, that (1) upon receipt of a claim, the parties may mutually agree to waive, in writing, mediation and proceed directly to the commencement of a civil action or binding arbitration, as applicable; and (2) a public entity may prescribe reasonable change order, claim, and dispute resolution procedures and requirements in addition to the provisions of this section, so long as the contractual provisions do not conflict with or otherwise impair the timeframes and procedures set forth in this section.

(g) This section applies to contracts entered into on or after January 1, 2017.

(h) Nothing in this section shall impose liability upon a public entity that makes loans or grants available through a competitive application process, for the failure of an awardee to meet its contractual obligations.

(i) This section shall remain in effect only until January 1, 2027, and as of that date is repealed, unless a later enacted statute, that is enacted before January 1, 2027, deletes or extends that date.

## **California Public Contract Code Sections 20104 – 20104.6**

### **Section 20104**

**(a)(1)** This article applies to all public works claims of three hundred seventy-five thousand dollars (\$375,000) or less which arise between a contractor and a local agency.

**(2)** This article shall not apply to any claims resulting from a contract between a contractor and a public agency when the public agency has elected to resolve any disputes pursuant to Article 7.1 (commencing with Section 10240) of Chapter 1 of Part 2.



**(b)(1)** "Public work" means "public works contract" as defined in Section 1101 but does not include any work or improvement contracted for by the state or the Regents of the University of California.

**(2)** "Claim" means a separate demand by the contractor for (A) a time extension, (B) payment of money or damages arising from work done by, or on behalf of, the contractor pursuant to the contract for a public work and payment of which is not otherwise expressly provided for or the claimant is not otherwise entitled to, or (C) an amount the payment of which is disputed by the local agency.

**(c)** The provisions of this article or a summary thereof shall be set forth in the plans or specifications for any work which may give rise to a claim under this article.

**(d)** This article applies only to contracts entered into on or after January 1, 1991.

### **Section 20104.2**

For any claim subject to this article, the following requirements apply:

**(a)** The claim shall be in writing and include the documents necessary to substantiate the claim. Claims must be filed on or before the date of final payment. Nothing in this subdivision is intended to extend the time limit or supersede notice requirements otherwise provided by contract for the filing of claims.

**(b) (1)** For claims of less than fifty thousand dollars (\$50,000), the local agency shall respond in writing to any written claim within 45 days of receipt of the claim, or may request, in writing, within 30 days of receipt of the claim, any additional documentation supporting the claim or relating to defenses to the claim the local agency may have against the claimant.

**(2)** If additional information is thereafter required, it shall be requested and provided pursuant to this subdivision, upon mutual agreement of the local agency and the claimant.

**(3)** The local agency's written response to the claim, as further documented, shall be submitted to the claimant within 15 days after receipt of the further documentation or within a period of time no greater than that taken by the claimant in producing the additional information, whichever is greater.

**(c) (1)** For claims of over fifty thousand dollars (\$50,000) and less than or equal to three hundred seventy-five thousand dollars (\$375,000), the local agency shall respond in writing to all written claims within 60 days of receipt of the claim, or may request, in writing, within 30 days of receipt of the claim, any additional documentation supporting the claim or relating to defenses to the claim the local agency may have against the claimant.

**(2)** If additional information is thereafter required, it shall be requested and provided pursuant to this subdivision, upon mutual agreement of the local agency and the claimant.

**(3)** The local agency's written response to the claim, as further documented, shall be submitted to the claimant within 30 days after receipt of the further documentation, or within a period of time no greater than that taken by the claimant in producing the additional information or requested documentation, whichever is greater.

**(d)** If the claimant disputes the local agency's written response, or the local agency fails to respond within the time prescribed, the claimant may so notify the local agency, in writing, either within 15 days of receipt of the local agency's response or within 15 days of the local agency's failure to respond within the time

prescribed, respectively, and demand an informal conference to meet and confer for settlement of the issues in dispute. Upon a demand, the local agency shall schedule a meet and confer conference within 30 days for settlement of the dispute.

**(e)** Following the meet and confer conference, if the claim or any portion remains in dispute, the claimant may file a claim as provided in Chapter 1 (commencing with Section 900) and Chapter 2 (commencing with Section 910) of Part 3 of Division 3.6 of Title 1 of the Government Code. For purposes of those provisions, the running of the period of time within which a claim must be filed shall be tolled from the time the claimant submits his or her written claim pursuant to subdivision (a) until the time that claim is denied as a result of the meet and confer process, including any period of time utilized by the meet and confer process.

**(f)** This article does not apply to tort claims and nothing in this article is intended nor shall be construed to change the time periods for filing tort claims or actions specified by Chapter 1 (commencing with Section 900) and Chapter 2 (commencing with Section 910) of Part 3 of Division 3.6 of Title 1 of the Government Code.

#### **Section 20104.4**

The following procedures are established for all civil actions filed to resolve claims subject to this article:

**(a)** Within 60 days, but no earlier than 30 days, following the filing or responsive pleadings, the court shall submit the matter to nonbinding mediation unless waived by mutual stipulation of both parties. The mediation process shall provide for the selection within 15 days by both parties of a disinterested third person as mediator, shall be commenced within 30 days of the submittal, and shall be concluded within 15 days from the commencement of the mediation unless a time requirement is extended upon a good cause showing to the court or by stipulation of both parties. If the parties fail to select a mediator within the 15-day period, any party may petition the court to appoint the mediator.

**(b) (1)** If the matter remains in dispute, the case shall be submitted to judicial arbitration pursuant to Chapter 2.5 (commencing with Section 1141.10) of Title 3 of Part 3 of the Code of Civil Procedure, notwithstanding Section 1141.11 of that code. The Civil Discovery Act (Title 4 (commencing with Section 2016.010) of Part 4 of the Code of Civil Procedure) shall apply to any proceeding brought under this subdivision consistent with the rules pertaining to judicial arbitration.

**(2)** Notwithstanding any other provision of law, upon stipulation of the parties, arbitrators appointed for purposes of this article shall be experienced in construction law, and, upon stipulation of the parties, mediators and arbitrators shall be paid necessary and reasonable hourly rates of pay not to exceed their customary rate, and such fees and expenses shall be paid equally by the parties, except in the case of arbitration where the arbitrator, for good cause, determines a different division. In no event shall these fees or expenses be paid by state or county funds.

**(3)** In addition to Chapter 2.5 (commencing with Section 1141.10) of Title 3 of Part 3 of the Code of Civil Procedure, any party who after receiving an arbitration award requests a trial de novo but does not obtain a more favorable judgment shall, in addition to payment of costs and fees under that chapter, pay the attorney's fees of the other party arising out of the trial de novo.

**(c)** The court may, upon request by any party, order any witnesses to participate in the mediation or arbitration process.

#### **Section 20104.6**

(a) No local agency shall fail to pay money as to any portion of a claim which is undisputed except as otherwise provided in the contract.

(b) In any suit filed under Section 20104.4, the local agency shall pay interest at the legal rate on any arbitration award or judgment. The interest shall begin to accrue on the date the suit is filed in a court of law.

## **DIVISION II GENERAL CONSTRUCTION**

### **12 TEMPORARY TRAFFIC CONTROL**

**Replace section 12-1.04 with:**

#### **12-1.04 FLAGGING COSTS**

You pay the cost of furnishing all flaggers, including transporting flaggers and furnishing stands and towers for flaggers to provide for the passage of traffic through the work as specified in sections 7-1.03 and 7-1.04.

**Replace section 12-2 with:**

#### **12-2 CONSTRUCTION PROJECT INFORMATION SIGNS**

##### **12-2.01 GENERAL**

Details for construction project information signs are in *Project Details*.

Keep construction project information signs clean and in good repair at all times.

##### **12-2.02 MATERIALS**

Provide Construction project information signs, posts, and mounting hardware.

Construction project information signs must be wood post signs complying with section 82-3 of the Standard Specifications. Each sign shall be supported by two 16-foot tall 4x4 smooth wood posts, painted white.

Sign panels for construction project information signs must be 4 feet tall by 8 feet wide and made of 3/4 inch thick exterior grade plywood.

The background on construction project information signs must be painted white.

Text shall be black on a white background.

The size of the text and logos on construction project information signs must be as described in the Project Details. Do not add any additional information unless authorized.

##### **12-2.03 CONSTRUCTION**

Provide and Install a total of 2 construction project information signs, one at each County Service Area, at the locations designated by the Engineer before starting major work activities visible to highway users.

The Contractor shall construct and maintain signage meeting the guidelines specified in the Project Details insert, DWSRF Sign Requirements. The sign shall be prominently displayed in a location visible to the public.

Upon completion and acceptance of the work, the signs shall be removed and become the property of the Contractor.

#### **12-2.04 PAYMENT**

The Department pays you for Construction Project Information Signs as follows:

1. 75 percent of the item upon installation of each sign
2. 100 percent of the item upon removal of each sign

#### **Replace Section 12-3.01C With:**

##### **12-3.01C Construction**

If channelizing devices are used on the project, perform all layout work necessary to place channelizing devices:

1. On the proper alignment
2. Uniformly at the location and spacing described
3. Straight on a tangent alignment
4. On a true arc in a curved alignment

If temporary traffic control devices are damaged, displaced, or stop operating or functioning as described from any cause during the progress of the work, immediately repair, repaint, or replace the components and restore them to their original locations and positions.

If ordered, furnish and place additional temporary traffic control devices. This work is not change order work if:

1. Required to conform with your traffic control plan
2. Required to conform with the MUTCD
3. Necessary for public safety or convenience as determined by the Engineer
4. Required to perform staged construction shown on the plans

#### **Replace Section 12-3.03C With:**

##### **12-3.03C Construction**

If plastic traffic drums are used on project, use 1 type of plastic traffic drum on the project.

Use the same type and brand of retroreflective sheeting for all plastic traffic drums used on the project.

Do not use sandbags or comparable ballast.

Moving plastic traffic drums from location to location if ordered after initial placement is not change order work if:

1. Required to conform with your traffic control plan
2. Required to conform with the MUTCD
3. Necessary for public safety or convenience as determined by the Engineer
4. Required to perform staged construction shown on the plans

#### **Replace Section 12-3.10C With:**

##### **12-3.10C Construction**

If barricades are used on the project, place each barricade such that the stripes slope downward in the direction road users are to pass.

Place each sand-filled bag near the ground level on the lower parts of the frame or stays to serve as ballast for the barricades. Do not place ballast on top of barricades or over any retroreflective barricade rail face that is facing traffic.

Do not remove barricades that are shown to be left in place at the time of work completion.

Moving a barricade from location to location is change order work if ordered after initial placement of the barricade unless.

1. Required to conform with your traffic control plan
2. Required to conform with the MUTCD
3. Necessary for public safety or convenience as determined by the Engineer
4. Required to perform staged construction shown on the plans

**Replace Section 12-3.20C(1) With:**

**12-3.20C1 General**

If type K temporary rail is used on the project, before placing Type K temporary railing on the job site, paint the exposed surfaces of the railing with white paint complying with the specifications for acrylic emulsion paint for exterior masonry.

Place Type K temporary railing on a firm, stable foundation. Grade the foundation to provide a uniform bearing surface throughout the entire length of the railing.

Structure excavation and backfill must comply with section 19-3 except compaction of earth fill placed behind Type K temporary railing in a curved layout is not required.

Place and maintain the abutting ends of PC concrete units in alignment without substantial offset from each other.

The drilling of holes and bonding of threaded rods or dowels must comply with the specifications for drilling and bonding dowels in section 51-1.

Install a reflector on the top or face of the rail of each rail unit placed within 10 feet of a traffic lane. Apply adhesive for mounting the reflector under the reflector manufacturer's instructions.

Install a Type P marker panel at each end of railing placed adjacent to a 2-lane, two-way highway and at the end facing traffic for railing installed adjacent to a one-way roadbed. If the railing is placed on a skew, install the marker at the end of the skew nearest the traveled way. Type P marker panels must comply with section 82 except you must furnish the marker panels.

After removing Type K temporary railing:

1. Restore the area to its previous condition or construct it to its planned condition if temporary excavation or embankment was used to accommodate the railing.
2. Remove all threaded rods or dowels to a depth of at least 1 inch below the surface of the concrete. Fill the resulting holes with mortar under section 51-1 except cure the mortar by the water method or by the curing compound method using curing compound no. 6.

If the Engineer orders a lateral move of Type K temporary railing and repositioning is not shown, the lateral move is change order work unless:

1. Required to conform with your traffic control plan
2. Required to conform with the MUTCD
3. Necessary for public safety or convenience as determined by the Engineer
4. Required to perform staged construction shown on the plans

**Replace Section 12-3.22C With:**

**12-3.22C Construction**

If crash cushion modules are used on the project, use the same type of crash cushion module for a single grouping or array.

Temporary crash cushion arrays must not encroach on the traveled way.

Secure the sand-filled modules in place before starting an activity requiring a temporary crash cushion.

Maintain sand-filled temporary crash cushions in place at each location, including times when work is not actively in progress. You may remove the crash cushions during the work shift for access to the work if the exposed fixed obstacle is 15 feet or more from the nearest lane carrying traffic. Reset the crash cushion before the end of the work shift.

Immediately repair sand-filled temporary crash cushion modules damaged due to your activities. Remove and replace any module damaged beyond repair. Repair and replacement of temporary crash cushion modules damaged by traffic are change order work.

You may place sand-filled temporary crash cushion modules on movable pallets or frames complying with the dimensions shown. The pallets or frames must provide a full-bearing base beneath the modules. Do not move the modules and supporting pallets or frames by sliding or skidding along the pavement or bridge deck.

Attach a Type R or Type P marker panel to the front of the temporary crash cushion if the closest point of the crash cushion array is within 12 feet of the traveled way. Firmly fasten the marker panel to the crash cushion with commercial quality hardware or by other authorized methods. Attach the Type R marker panel such that the top of the panel is 1 inch below the module lid. Attach the Type P marker panel such that the bottom of the panel rests upon the pallet or roadway surface if pallets are not used.

A lateral move of a temporary crash cushion module is change order work if ordered and the repositioning is not shown, unless required for staged construction.

Remove sand-filled temporary crash cushion modules, including sand, pallets or frames, and marker panels, at Contract acceptance. Do not install sand-filled temporary crash cushion modules in the permanent work.

**Replace section 12-3.31C with:**

**12-3.31C Construction**

If portable flashing beacons are used on the project, remove portable flashing beacons from the traveled way at the end of each night's work. You may store the flashing beacon at selected central locations within the highway where designated by the Engineer.

Moving portable flashing beacons from location to location if ordered after initial placement is change order work unless:

1. Required to conform with your traffic control plan
2. Required to conform with the MUTCD
3. Necessary for public safety or convenience as determined by the Engineer
4. Required to perform staged construction shown on the plans

**Replace Section 12-3.35B(6) with:**

**12-3.35B(6) User Interface**

If the project includes an AWIS, the system must have a user interface to control the AWIS PCMS communications. The interface must be (1) software compatible with a Windows environment or (2) a web service accessed by a web browser.

Provide any software on a CD or other Engineer-authorized data-storage device.

The user interface must, at a minimum, provide the user with a list of AWIS PCMSs in the field, location information for each AWIS PCMS, and a real-time on-board display of the message in the field. Control options must, at a minimum, provide the user the ability to change the on-board messages and flash rate.

**Replace the headings and paragraphs of Section 12-4 with:**

## **12-4 MAINTAINING TRAFFIC**

### **12-4.01 GENERAL**

#### **12-4.01A General**

Section 12-4.01 includes general specifications for maintaining traffic through construction work zones.

If local authorities regulate traffic, notify them at least 5 business days before the start of job site activities. Cooperate with the local authorities to handle traffic through the work zone and to make arrangements to keep the work zone clear of parked vehicles.

#### **12-4.01B Materials**

Not Used

#### **12-4.01C CONSTRUCTION**

Furnishing and operating pilot cars is not change order work.

#### **12-4.01D Payment**

Not Used

### **12-4.02 TRAFFIC CONTROL SYSTEMS**

#### **12-4.02A General**

##### **12-4.02A(1) Summary**

Section 12-4.02 includes specifications for providing a traffic control system to close traffic lanes, shoulders, and roadways.

A traffic control system for a closure includes the temporary traffic control devices described as part of the traffic control system. Temporary traffic control devices must comply with section 12-3.

##### **12-4.02A(2) Definitions**

**designated holidays:** Designated holidays are shown as “holidays” in Section 1-1.07B.

##### **12-4.02A(3) Submittals**

###### **12-4.02A(3)(a) General**

The Contractor shall prepare and submit to the County Construction Engineer for approval, a traffic control system plan indicating the means and methods he will employ to institute and maintain traffic control for all phases of the work within the project. The traffic control system plan shall be submitted to the County Construction Engineer as early as possible, preferably **five (5) working days** prior to pre-construction meeting. The Engineer will require five (5) working days to review the initial submittal of the traffic control system plan and an additional five (5) working days for each successive review.

**No work at the project site whatsoever, including preparatory work such as the installation of construction project funding signs, shall commence until the traffic control system plan has been approved in writing by the Engineer. In the event that the traffic control system plan is not submitted timely, the Engineer may issue a notice of commencement of contract time prior to approval of the traffic control system plan, and working days will begin to accrue against the allotted contract time.**

Late submittal of the traffic control plan or revisions thereafter required, due to the inadequacy of the plan, shall not be accepted as justification for the delay in the start of the working days for the project.

It shall be the Contractor's responsibility to provide, install, maintain, and remove any and all detour signage and traffic control devices and to obtain all permits, including permits from Caltrans, as may be necessary to establish detours as part of the contractor's traffic control plan.

Traffic will not be allowed to be limited to one direction when construction activities are not actively in progress. Providing, installing, maintaining, and removing all traffic control, including portable changeable message signs if required, obtaining and complying with all permits, and providing all traffic control operations shall be the responsibility of the contractor, and no additional compensation will be allowed therefor.

#### **12-4.02A(3)(b) Closure Schedules**

One-way traffic shall be controlled through the project in accordance with the California Manual MUTCD and Caltrans Standard Plans T-11 and T-13 entitled "Traffic Control System for Lane Closure on Multilane Conventional Highways" and "Traffic Control System for Lane Closure on Two Lane Conventional Highways," and these special provisions. Night closure will not be permitted.

When traffic is under one way control on unpaved areas, the cones shown along the centerline on the plan need not be placed.

Every Monday by noon, submit a closure schedule request for planned closures for the next week.

The next week is defined as Sunday at noon through the following Sunday at noon.

Submit a closure schedule request 5 days before the anticipated start of any job site activity that reduces:

1. Horizontal clearances of traveled ways, including shoulders, to 2 lanes or fewer due to activities such as temporary barrier placement and paving
2. Vertical clearances of traveled ways, including shoulders, due to activities such as pavement overlays, overhead sign installation, or falsework girder erection

Submit closure schedule changes, including additional closures, by noon at least 3 business days before a planned closure.

Cancel closure requests at least 48 hours before the start time of the closure.

The Department notifies you of unauthorized closures or closures that require coordination with other parties as a condition for authorization.

#### **12-4.02A(3)(c) Contingency Plans for Closures**

Submit a contingency plan for an activity that could affect a closure if a contingency plan is specified in the special provisions or if a contingency plan is requested.

If a contingency plan is requested, submit the contingency plan within 1 business day of the request.

The contingency plan must identify the activities, equipment, processes, and materials that may cause a delay in the opening of a closure to traffic. The plan must include:

1. List of additional or alternate equipment, materials, or workers necessary to ensure continuing activities and on-time opening of closures if a problem occurs. If the additional or alternate equipment, materials, or workers are not on the job site, specify their location, the method for mobilizing these items, and the required time to complete mobilization.
2. General time-scaled logic diagram displaying the major activities and sequence of the planned activities. For each activity, identify the critical event that will activate the contingency plan.

Submit revisions to a contingency plan at least 3 business days before starting the activity requiring the contingency plan. Allow 2 business days for review.



#### **12-4.02A(4) Quality Assurance**

Reserved

#### **12-4.02B Materials**

Not Used

#### **12-4.02C Construction**

##### **12-4.02C(1) General**

Traffic will be controlled by flagmen by eyesight, radio (walkie talkie) or baton. In the event these methods do not work satisfactorily, as determined by the Engineer, a pilot car will be required.

The Engineer may require a pilot car to be used during earthwork operations in preparation of the grading plane or other operations when the Contractor's operations cover an area beyond the line of sight, or beyond the range of radios or when the baton method does not function satisfactorily.

Work that interferes with traffic is limited to the hours when closures are allowed.

Additional advance flaggers are required.

For traffic under 1-way control on unpaved areas, the cones along the centerline need not be placed.

You may use a pilot car to control traffic. If a pilot car is used for traffic control, the cones along the centerline need not be placed. The pilot car must have radio contact with personnel in the work area. Operate the pilot car through the traffic control zone at a speed not greater than 25 miles per hour.

##### **12-4.02C(3) Closure Requirements and Charts**

###### **12-4.02C(3)(a) General**

Where 2 or more lanes in the same direction, including the shoulders, are adjacent to the area where the work is being performed, close the adjacent lane under any of the following conditions:

1. Work is off the traveled way but within 6 feet of the edge of the traveled way, and the approach speed is greater than 45 mph
2. Work is off the traveled way but within 3 feet of the edge of the traveled way, and the approach speed is less than 45 mph

Closure of the adjacent traffic lane is not required during any of the following activities:

1. Work behind a barrier
2. Paving, grinding, or grooving
3. Installation, maintenance, or removal of traffic control devices except for temporary railing

###### **12-4.02C(3)(b) - 12-4.02C(3)(n)**

Reserved

###### **12-4.02C(3)(o) Closure of Conventional County Roads**

The type and location of signs, lights, flags, flagmen, and other traffic control and safety devices shall be in accordance with the current edition of the California Manual on Uniform Traffic Control Devices (MUTCD) issued by the State of California, Department of Transportation (Caltrans).

Public traffic shall be permitted to pass through construction at all times unless otherwise specified herein.

Provide access to properties abutting the project site at all times.

Whenever possible, the Contractor will be required to maintain one paved traffic lane, not less than 10 feet wide in each direction at all time. Only locations where roads are not wide enough, one lane traffic will be allowed as per these specifications.

When directed by the Engineer, traffic shall be routed through the work under one-way control.

Under one-way reversing traffic control operations, public traffic may be stopped in one direction for periods not to exceed 10 minutes.

Lane closure is defined as the closure of a traffic lane or lanes within a single traffic control system.

The full width of the traveled way shall be open for use by public traffic when construction operations are not actively in progress.

Driveways and access roads shall remain accessible at all times.

Valley gutters shall be constructed in one-half widths and the remaining one-half width shall be kept free from obstructions to allow local traffic and through traffic to pass.

Personal vehicles of the Contractor's employees shall not be parked on the traveled way or shoulders including sections closed to public traffic.

When work vehicles or equipment are parked on the shoulder within 6 feet of a traffic lane, the shoulder area shall be closed as shown on standard plan T-10.

The Contractor's equipment and materials shall not remain in a lane except when such lane is closed to traffic and the lane is being used for contract operations.

**12-4.02C(3)(o)–12-4.02C(3)(s) Reserved**

**12-4.02C(4)–12.4.02C(6) Reserved**

**12-4.02C(7) Traffic Control System Requirements**

**12-4.02C(7)(a) General**

Control traffic using stationary closures.

If components of the traffic control system are displaced or cease to operate or function as specified, immediately repair them to their original condition or replace them and place them back in their original locations.

Vehicles equipped with attenuators must comply with section 12-3.23.

Each vehicle used to place, maintain, and remove components of a traffic control system on a multilane highway must have a Type II flashing arrow sign that must operate whenever the vehicle is used for placing, maintaining, or removing the components. For a stationary closure, vehicles with a Type II flashing arrow sign not involved in placing, maintaining, or removing the components must display only the caution display mode. If a flashing arrow sign is required for a closure, activate the sign before the closure is in place.

**12-4.02C(7)(b) Stationary Closures**

Except for channelizing devices placed along open trenches or excavations adjacent to the traveled way, remove the components of the traffic control system for a stationary closure from the traveled way and shoulders at the end of each work period. You may store the components at authorized locations within the limits of the highway.

If a traffic lane is closed with channelizing devices for excavation work, move the devices to the adjacent edge of the traveled way when not excavating. Space the devices as shown for the lane closure.

**12-4.02C(7)(c) Moving Closures**

For a moving closure, use a PCMS that complies with section 12-3.32 except the sign must be truck mounted. The full operational height to the bottom of the sign may be less than 7 feet above the ground but must be as high as practicable.

If you use a flashing arrow sign in a moving closure, the sign must be truck mounted. Operate the flashing arrow sign in the caution display mode if it is being used on a 2-lane, two-way highway.

## **12-4.02C(8) Traffic Control System Signs**

### **12-4.02C(8)(a) General**

Traffic control system signs must comply with section 12-3.11.

### **12-4.02C(8)(b) Connector and Ramp Closure Signs**

Inform motorists of a temporary closing of a (1) connector or a (2) freeway or expressway entrance or exit ramp using:

1. SC6-3(CA) (Ramp Closed) sign for closures of 1 day or less
2. SC6-4(CA) (Ramp Closed) sign for closures of more than 1 day

SC6-3(CA) and SC6-4(CA) signs must be stationary mounted at the locations shown and must remain in place and visible to motorists during the connector or ramp closure.

Notify the Engineer at least 2 business days before installing the sign and install the sign from 7 to 15 days before the closure.

### **12-4.02C(10)–12-4.02C(11) Reserved**

### **12-4.02C(12) Failure to Provide Traffic Control.**

If you do not provide the traffic control and it becomes necessary for the Engineer to notify you of your duties according to the Standard Specifications and these special provisions, you will pay \$200 per 15-minute period or portion thereof to the County for all the time required to acquire the traffic control, including pilot car.

Such payment shall commence at the time notice of the improper traffic control condition is given to you or your authorized representative by the Engineer and shall terminate when the condition is corrected. Such payment will be deducted from your payment.

In addition thereto, when it is necessary for the Engineer to perform the work, you will pay the actual cost for the performance thereof. Such amount will be deducted from the your payment. This will be in addition to any penalties imposed in these special provisions.

The provisions in this section will not relieve you from your responsibility to provide such additional devices or take such measures as may be necessary to comply with the provisions in Section 7-1.04, "Public Safety," of the Standard Specifications.

### **12-4.02D Payment**

The Department pays for change order work for a traffic control system by force account for increased traffic control and uses a force account analysis for decreased traffic control.

Traffic control system for lane closure is paid for as traffic control system. Flagging costs are paid for as specified in section 12-1.04.

The requirements in section 4-1.05 for payment adjustment do not apply to traffic control system. Adjustments in compensation for traffic control system will be made for an increase or decrease in traffic control work if ordered and will be made on the basis of the cost of the necessary increased or decreased traffic control. The adjustment will be made on a force account basis for increased work and estimated on the same basis in the case of decreased work.

A traffic control system required by change order work is paid for as a part of the change order work.

Full compensation for furnishing and operating the pilot car, (including driver, radios, and any other equipment and labor required) shall be considered as included in the contract lump sum price paid for traffic control system and no further payment will be made.

## **12-4.03 FALSEWORK OPENINGS**

Reserved

#### **12-4.04 PEDESTRIAN FACILITIES**

##### **12-4.04A General**

Section 12-4.04 includes specifications for providing temporary pedestrian facilities.

Temporary pedestrian facilities must comply with section 16-2.02.

##### **12-4.04B Materials**

Not Used

##### **12-4.04C Construction**

If pedestrian traffic is allowed to pass through work areas, provide a temporary pedestrian facility through the construction areas within the highway. Include a protective overhead covering as necessary to ensure protection from falling objects and drippings from overhead structures.

If an activity requires a closure of a walkway, provide another walkway nearby, off of the traveled way.

Where pedestrian openings through falsework are required, provide a temporary pedestrian facility with a protective overhead covering during all bridge construction activities.

##### **12-4.04D Payment**

Not Used

#### **12-4.06–12-4.10 RESERVED**

## **13 WATER POLLUTION CONTROL**

### **Add to Section 13-1.01:**

#### **STATE WATER RESOURCES CONTROL BOARD (SWRCB) NOTICE OF INTENT FILING (NOI) FEE**

Complete the NOI filing process started by the County on the SWRCB website using information available in the contract, field and website. The Engineer will link your plan to the project on the SWRCB website. Refer to Section 01 22 00 EXPLANATION OF BID ITEMS for payment.

The provisions of section 9-1.06 for increased or decreased quantities shall not apply to the "State Water Resources Control Board - Notice of Intent" bid item.

The SWRCB website can be found at:

**<https://smarts.waterboards.ca.gov/smarts/faces/SwSmartsLogin.xhtml>**

The dollar amount shown in the Proposal is an estimate only and shall be included in each bidder's proposal.

### **Replace 13-1.01A with:**

#### **13-1.01A Summary**

Section 13-1 includes general specifications for preventing, controlling, and abating water pollution within waters of the State.

Information on forms, reports, and other documents is in the following Caltrans manuals:

1. Field Guide to Construction Site Dewatering
2. Stormwater Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual

3. Construction Site Best Management Practices (BMPs) Manual
4. Construction Site Monitoring Program Guidance Manual

You may view these manuals at the Stormwater and Water Pollution Control Information link at the Caltrans Division of Construction website or purchase them at the Caltrans Publication Distribution Unit.

A WPCP and a SWPPP must comply with the Caltrans Stormwater Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual and must be prepared using the latest template posted on the Construction stormwater website.

**Replace Section 13-1.01D92) with**

**13-1.01D(2) Regulatory Requirements**

Comply with the discharge requirements in the NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities; Order No. 2009-000 9-DWQ, CAS000002 (Construction General Permit) and any amendments thereto issued by the SWRCB. The Construction General Permit may be found at:

[http://www.waterboards.ca.gov/water\\_issues/programs/stormwater/constpermits.shtml](http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml)

Discharges from manufacturing facilities, such as batch plants and crushing plants, must comply with the discharge requirements in the NPDES General Permit for Storm Water Discharges Associated with Industrial Activities; Order No. 2014-0057-DWQ, CAS000001 (Industrial General Permit), issued by the SWRCB. For the Industrial General Permit, go to the SWRCB website.

For a batch plant and crushing plant outside a job site or within a job site that serves one or more contracts, obtain coverage under the Industrial General Permit before operating a batch plant to manufacture concrete, HMA, or other material or a crushing plant to produce rock or aggregate.

This Project disturbs 1.2 acres of soil.

**Replace Section 13-1.01D(4)(b) with:**

**13-1.01D(4)(b) Qualifications**

The WPC manager must:

1. Comply with the requirements provided in the Construction General Permit for:
  - 1.1. QSP if the project requires a WPCP
  - 1.2. QSD if the project requires a SWPPP
2. Complete the stormwater management training described at the Stormwater and Water Pollution Control Information link at the Caltrans Division of Construction website

**Add to section 13-3.01A:**

This project's risk level is 1.

**Add between the 4th and 5th paragraphs of section 13-3.01C(2)(a):**

The Central Valley Regional Water Quality Control Board will review the authorized SWPPP.

**Replace Section 13-3.01C(5) with:**

**13-3.01C(5) Annual Certification**

Submit an annual certification of compliance as described in the Caltrans *Stormwater Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual* before July 15th of each year.

**Replace Section 13-4.03G with:**

**13-4.03G Dewatering**

Dewatering consists of discharging accumulated stormwater, groundwater, or surface water from excavations or temporary containment facilities.

If dewatering is required, perform dewatering work as specified for the work items involved, such as a temporary ATS or dewatering and discharge.

If dewatering and discharging activities are not specified for a work item and you perform dewatering activities:

1. Conduct dewatering activities under the Caltrans *Field Guide for Construction Site Dewatering*.
2. Ensure any dewatering discharge does not cause erosion, scour, or sedimentary deposits that could impact natural bedding materials.
3. Discharge the water within the project limits. Dispose of the water if it cannot be discharged within project limits due to site constraints or contamination.
4. Do not discharge stormwater or non-stormwater that has an odor, discoloration other than sediment, an oily sheen, or foam on the surface. Immediately notify the Engineer upon discovering any such condition.

**Replace Section 13-5.04 with:**

**13-5.04 PAYMENT**

The payment quantity for temporary soil stabilization bid items paid for by the area is the area measured parallel with the ground surface not including the additional quantity used for overlaps.

If there is no bid item for temporary soil stabilization measures, payment therefor is considered to be included in the bid item for prepare water pollution control program or in the bid item for prepare and implement stormwater pollution prevention plan, as applicable.

**Replace Section 13-6.04 with:**

**13-6.04 PAYMENT**

The payment quantity for temporary sediment control bid items paid for by the length is the length measured along the centerline of the installed material.

The payment quantity, if any, for temporary fiber roll does not include the additional quantity used for overlaps.

The Department does not pay for the relocation of temporary drainage inlet protection during work progress.

If there are no bid items for installing or maintaining temporary sediment control measures, payment therefor is considered to be included in the bid item for prepare water pollution control program or in the bid item for prepare and implement stormwater pollution prevention plan, as applicable.

**Replace Section 13-7.03D with:**

**13-7.03D Payment**

The Department does not pay for the relocation of temporary construction entrances or roadways during work progress.

If there are no bid items for installing or maintaining temporary construction entrances or roadways, payment therefor is considered to be included in the bid item for prepare water pollution control program or in the bid item for prepare and implement stormwater pollution prevention plan, as applicable.

**13-8 RESERVED**

## **14 ENVIRONMENTAL STEWARDSHIP (WILL BE REPLACED)**

**Add Section 14-12.04:**

### **14-12.04 RELATIONS WITH SAN JOAQUIN VALLEY AIR POLLUTION CONTROL DISTRICT (SJVAPCD)**

You are responsible for compliance with all applicable SJVAPCD regulations and requirements. This section is provided for your information, and nothing herein or elsewhere within these special provisions shall be construed as limiting your responsibility for complying with all applicable rules and regulations.

In accordance with SJVAPCD Regulation VIII – Fugitive PM10 Prohibitions: Rule 8021, an SJVAPCD-approved dust control plan is NOT required for this project. However, you are required to notify the SJVAPCD prior to commencing construction operations, and you are responsible for compliance with all applicable rules and regulations of the SJVAPCD and the requirements listed in Section 01 57 27 Dust Control of the technical specifications.

**Replace Section 14-12.04–14.12.08 With:**

**14-12.05–14.12.08 RESERVED**

## **16 TEMPORARY FACILITIES**

**Replace section 16-1.02 with:**

### **16-1.02 Materials**

Where concrete driveway modifications are required, a temporary access ramp shall be constructed using excavated earthy material to allow access to the properties.

## **DIVISION III EARTHWORK AND LANDSCAPE**

### **17 GENERAL**

**Replace the 4th paragraph in section 17-2.03A with:**

Clear and grub vegetation only within the immediate limits required for the installations of the contract facilities.

**Replace the 1<sup>st</sup> sentence in the 2<sup>nd</sup> paragraph in section 17-2.03A with:**

Cut tree branches that extend over the roadway and hang within 20 feet of finished grade and as directed by the engineer.

**Add to end of 17-2.03C:**

Any trees with a trunk diameter greater than or equal to 4" will constitute as a "tree removal" and will have separate bid item. Any tree or shrub less than 4" shall be considered in the bid item for "clearing and grubbing".

## DIVISION V SURFACINGS AND PAVEMENTS

Replace the headings and paragraphs of Section 36-3 with:  
**36-3 PAVEMENT SMOOTHNESS**

### **36-3.01 GENERAL**

#### **36-3.01A Summary**

Section 36-3 includes specifications for measuring the smoothness of pavement surfaces.

#### **36-3.01B Definitions**

Reserved

#### **36-3.01C Submittals**

##### **36-3.01C(1) General**

Reserved

##### **36-3.01C(2) Reserved**

##### **36-3.01C(3) Reserved**

##### **36-3.01C(4) Straightedge Measurements**

Within 2 business days of measuring smoothness with a straightedge, submit a list of the areas requiring smoothness correction. Identify the areas by:

1. Location number
2. District-County-Route
3. Beginning station or post mile to the nearest 0.01 mile
4. For correction areas within a traffic lane:
  - 4.1. Lane direction, *NB*, *SB*, *EB*, or *WB*
  - 4.2. Lane number from left to right in the direction of travel
  - 4.3. Wheel path, *L* for left, *R* for right, or *B* for both
5. For correction areas not within a traffic lane:
  - 5.1. Identify the pavement area, such as shoulder, weigh station, or turnout
  - 5.2. Direction and distance from the centerline, *L* for left or *R* for right
6. Estimated size of correction area

#### **36-3.01D Quality Assurance**

##### **36-3.01D(1) General**

Reserved

##### **36-3.01D(2) Reserved**

##### **36-3.01D(3) Quality Control**

###### **36-3.01D(3)(a) General**

Reserved

###### **36-3.01D(3)(b) Smoothness**

###### **36-3.01D(3)(b)(i) General**

Test pavement smoothness using a 12-foot straightedge for the pavement at:

1. Traffic lanes less than 1,000 feet in length, including ramps, turn lanes, and acceleration and deceleration lanes
2. Areas within 15 feet of manholes
3. Shoulders



4. Weigh-in-motion areas
5. Miscellaneous areas such as medians, gore areas, turnouts, and maintenance pullouts
6. Any other areas selected by the Engineer.

**36-3.01D(3)(b)(ii) Reserved**

**36-3.01D(3)(b)(iii) Reserved**

**36-3.01D(4) Department Acceptance**

The Department accepts pavement surfaces for smoothness based on compliance with the smoothness specifications for the type of pavement surface specified.

For areas that require pavement smoothness determined using a 12-foot straightedge, the pavement surface must not vary from the lower edge of the straightedge by more than:

1. 0.01 foot when the straightedge is laid parallel with the centerline
2. 0.02 foot when the straightedge is laid perpendicular to the centerline and extends from edge to edge of a traffic lane
3. 0.02 foot when the straightedge is laid within 24 feet of a pavement conform

**36-3.02 MATERIALS**

Not Used

**36-3.03 CONSTRUCTION**

Perform pavement smoothness testing in areas selected by the Engineer in the presence of the Engineer.

**36-3.04 PAYMENT**

Not Used

**Replace Section 39 with:**

**39 ASPHALT CONCRETE**

**39-1 GENERAL**

**39-1.01 GENERAL**

Section 39 includes specifications for performing asphalt concrete work.

**39-1.02 MATERIALS**

Not Used

**39-1.03 CONSTRUCTION**

Not Used

**39-1.04 PAYMENT**

Not Used

**39-2 HOT MIX ASPHALT**

**39-2.01 GENERAL**

**39-2.01A General**

**39-2.01A(1) Summary**

Section 39-2.01 includes general specifications for producing and placing hot mix asphalt.

HMA includes one or more of the following types:

1. Type A HMA

2. RHMA-G
3. OGFC
4. BWC
5. Minor HMA

WMA technologies must be on the Authorized Material List for WMA authorized technologies.

For HMA that uses asphalt binder containing crumb rubber modifier, submit a Crumb Rubber Usage Report form monthly and at the end of the project.

Wherever reference is made to the following test methods, the year of publication for these test methods is as shown in the following table:

Test method	Year of publication
AASHTO M 17	2011 (2015)
AASHTO M 323	2013
AASHTO R 30	2002 (2015)
AASHTO R 35	2014
AASHTO T 27	2014
AASHTO T 49	2014
AASHTO T 59	2013
AASHTO T 96	2002 (2010)
AASHTO T 164	2014
AASHTO T 176	2008
AASHTO T 209	2012
AASHTO T 269	2014
AASHTO T 275	2007 (2012)
AASHTO T 283	2014
AASHTO T 304	2011
AASHTO T 305	2014
AASHTO T 308	2010
AASHTO T 312	2014
AASHTO T 324	2014
AASHTO T 329	2013
AASHTO T 335	2009
ASTM D36/D36M	2014 <sup>ε1</sup>
ASTM D92	2012b
ASTM D217	2010
ASTM D297	2013
ASTM D445	2014
ASTM D2007	2011
ASTM D2074	2007 (Reapproved 2013)
ASTM D2995	1999 (Reapproved 2009)
ASTM D4791	2010
ASTM D5329	2009
ASTM D7741/D7741M	2011 <sup>ε1</sup>
Asphalt Institute MS-2	7th edition (2015)

### 39-2.01A(2) Definitions

**binder replacement:** Binder from RAP expressed as a percent of the total binder in the mix.

**coarse aggregate:** Aggregate retained on a no. 4 sieve.

**fine aggregate:** Aggregate passing a no. 4 sieve.

**leveling course:** Thin layer of HMA used to correct minor variations in the longitudinal and transverse profile of the pavement before placement of other pavement layers.

**miscellaneous areas:** Areas outside the traveled way and shoulders such as:

1. Median areas not including inside shoulders
2. Island areas
3. Sidewalks
4. Gutters
5. Ditches
6. Overside drains
7. Aprons at ends of drainage structures
8. Driveways and driveway approaches

**processed RAP:** RAP that has been fractionated.

**supplemental fine aggregate:** Mineral filler consisting of rock dust, slag dust, hydrated lime, hydraulic cement, or any combination of these and complying with AASHTO M 17.

### **39-2.01A(3) Submittals**

#### **39-2.01A(3)(a) General**

Reserved

#### **39-2.01A(3)(b) Job Mix Formula**

##### **39-2.01A(3)(b)(i) General**

Except for the HMA to be used in miscellaneous areas and dikes, submit your proposed JMF for each type of HMA to be used. The JMF must be submitted on the Contractor Job Mix Formula Proposal form along with:

1. Mix design documentation on Contractor Hot Mix Asphalt Design Data form dated within 12 months of submittal
2. JMF verification on a Caltrans Hot Mix Asphalt Verification form, if applicable
3. JMF renewal on a Caltrans Job Mix Formula Renewal form, if applicable
4. SDS for:
  - 4.1. Asphalt binder
  - 4.2. Supplemental fine aggregate except fines from dust collectors
  - 4.3. Antistrip additives

The Contractor Hot Mix Asphalt Design Data form must show documentation on aggregate quality.

If you cannot submit a Department-verified JMF on a Caltrans Hot Mix Asphalt Verification form dated within 12 months before HMA production, the Engineer verifies the JMF.

Submit a new JMF if you change any of the following:

1. Target asphalt binder percentage greater than  $\pm 0.2$  percent
2. Asphalt binder supplier
3. Combined aggregate gradation
4. Aggregate sources
5. Liquid antistrip producer or dosage
6. Average binder content in a new processed RAP stockpile by more than  $\pm 2.00$  percent from the average RAP binder content reported on page 4 of your Contractor Hot Mix Asphalt Design Data form
7. Average maximum specific gravity in a new processed RAP stockpile by more than  $\pm 0.060$  from the average maximum specific gravity value reported on page 4 of your Contractor Hot Mix Asphalt Design Data form
8. Any material in the JMF, except lime supplier and source

Allow the Engineer 5 business days from a complete JMF submittal for document review of the aggregate qualities, mix design, and JMF. The Engineer notifies you if the proposed JMF submittal is accepted.

If your JMF fails verification testing, submit an adjusted JMF based on your testing. The adjusted JMF must include a new Contractor Job Mix Formula Proposal form, Contractor Hot Mix Asphalt Design Data form, and the results of the failed verification testing.

You may submit an adjusted aggregate gradation TV on a Contractor Job Mix Formula Proposal form before verification testing. Aggregate gradation TV must be within the TV limits specified.

### **39-2.01A(3)(b)(ii) Job Mix Formula Renewal**

You may request a JMF renewal by submitting:

1. Proposed JMF on a Contractor Job Mix Formula Proposal form
2. Previously verified JMF documented on a Caltrans Hot Mix Asphalt Verification form dated within 12 months
3. Mix design documentation on a Contractor Hot Mix Asphalt Design Data form used for the previously verified JMF

### **39-2.01A(3)(b)(iii) Job Mix Formula Modification**

For an authorized JMF, submit a modified JMF if you change any of the following:

1. Asphalt binder supplier
2. Liquid antistrip producer
3. Liquid antistrip dosage

You may change any of the above items only once during the Contract.

Submit your modified JMF request at least 15 days before production. Each modified JMF submittal must include:

1. Proposed modified JMF on Contractor Job Mix Formula Proposal form, marked *Modified*.
2. Mix design records on Contractor Hot Mix Asphalt Design Data form for the authorized JMF to be modified.
3. JMF verification on Hot Mix Asphalt Verification form for the authorized JMF to be modified.
4. Test results for the modified JMF in compliance with the mix design specifications. Perform tests at the mix design OBC as shown on the Contractor Asphalt Mix Design Data form.

With an accepted modified JMF submittal, the Engineer verifies each modified JMF within 10 days of receiving all verification samples.

### **39-2.01A(3)(c) Quality Control Plan**

With your proposed JMF submittal, submit a QC plan for HMA.

The QC plan must describe the organization and procedures for:

1. Controlling HMA quality characteristics
2. Taking samples, including sampling locations
3. Establishing, implementing, and maintaining QC
4. Determining when corrective actions are needed
5. Implementing corrective actions
6. Using methods and materials for backfilling core locations

The QC plan must address the elements affecting HMA quality, including:

1. Aggregates
2. Asphalt binder
3. Additives

4. Production
5. Paving

The QC plan must include aggregate QC sampling and testing during lime treatment.

The QC Plan must include action and suspension limits and details of corrective action to be taken if any process is outside of those limits. Suspension limits must not exceed specified acceptance criteria.

The QC plan must describe how test results will be submitted including times for sampling and testing for each quality characteristic.

Allow 5 business days for review of the QC plan.

If you change QC procedures, personnel, or sample testing locations, submit a QC plan supplement before implementing the proposed change. Allow 3 business days for review of the QC plan supplement.

#### **39-2.01A(3)(d) Test Results**

For mix design, JMF verification, production start-up, and each 10,000 tons, submit AASHTO T 283 and AASHTO T 324 (Modified) test results to the Engineer.

Submit all QC test results, except AASHTO T 283 and AASHTO T 324 (Modified), within 3 business days of a request. Submit AASHTO T 283 QC tests within 15 days of sampling.

For tests performed under AASHTO T 324 (Modified), submit test data and 1 tested sample set within 5 business days of sampling.

If coarse and fine durability index tests are required, submit test results within 2 business days of sampling.

If a tapered notched wedge is used, submit compaction test result values within 24 hours of testing.

#### **39-2.01A(3)(e) Reserved**

#### **39-2.01A(3)(f) Liquid Antistrip Treatment**

If liquid antistrip treatment is used, submit the following with your proposed JMF submittal:

1. One 1 pt sample
2. Infrared analysis, including copy of absorption spectra
3. Certified copy of test results
4. Certificate of compliance for each liquid antistrip shipment. On each certificate of compliance, include:
  - 4.1. Your signature and printed name
  - 4.2. Shipment number
  - 4.3. Material type
  - 4.4. Material specific gravity
  - 4.5. Refinery
  - 4.6. Consignee
  - 4.7. Destination
  - 4.8. Quantity
  - 4.9. Contact or purchase order number
  - 4.10. Shipment date
5. Proposed proportions for the liquid antistrip

For each delivery of liquid antistrip to the HMA production plant, submit a 1 pt sample to the Engineer. Submit shipping documents. Label each liquid antistrip sampling container with:

1. Liquid antistrip type
2. Application rate
3. Sample date
4. Contract number

At the end of each day's production shift, submit production data in electronic media. Present data on electronic media in a tab delimited format. Use line feed carriage return with 1 separate record per line for each production data set. Allow enough fields for the specified data. Include data titles at least once per report. For each HMA mixing plant type, submit the following information in the order specified:

1. For batch plant mixing:
  - 1.1. Production date
  - 1.2. Time of batch completion
  - 1.3. Mix size and type
  - 1.4. Each ingredient's weight
  - 1.5. Asphalt binder content as a percentage of the total weight of mix
  - 1.6. Liquid antistriper content as a percentage of the asphalt binder weight
2. For continuous mixing plant:
  - 2.1. Production date
  - 2.2. Data capture time
  - 2.3. Mix size and type
  - 2.4. Flow rate of wet aggregate collected directly from the aggregate weigh belt
  - 2.5. Aggregate moisture content as a percentage of the dry aggregate weight
  - 2.6. Flow rate of asphalt binder collected from the asphalt binder meter
  - 2.7. Flow rate of liquid antistriper collected from the liquid antistriper meter
  - 2.8. Asphalt binder content as a percentage of the total weight of mix calculated from:
    - 2.8.1. Aggregate weigh belt output
    - 2.8.2. Aggregate moisture input
    - 2.8.3. Asphalt binder meter output
  - 2.9. Liquid antistriper content as a percentage of the asphalt binder weight calculated from:
    - 2.9.1. Asphalt binder meter output
    - 2.9.2. Liquid antistriper meter output

### **39-2.01A(3)(g) Lime Treatment**

If aggregate lime treatment is used, submit the following with your proposed JMF submittal and each time you produce lime-treated aggregate:

1. Exact lime proportions for fine and coarse virgin aggregates
2. If marination is required, the averaged aggregate quality test results within 24 hours of sampling
3. For dry lime aggregate treatment, a treatment data log from the dry lime and aggregate proportioning device in the following order:
  - 3.1. Treatment date
  - 3.2. Time of day the data is captured
  - 3.3. Aggregate size being treated
  - 3.4. HMA type and mix aggregate size
  - 3.5. Wet aggregate flow rate collected directly from the aggregate weigh belt
  - 3.6. Aggregate moisture content, expressed as a percentage of the dry aggregate weight
  - 3.7. Flow rate of dry aggregate calculated from the flow rate of wet aggregate
  - 3.8. Dry lime flow rate
  - 3.9. Lime ratio from the authorized JMF for each aggregate size being treated
  - 3.10. Lime ratio from the authorized JMF for the combined aggregates
  - 3.11. Actual lime ratio calculated from the aggregate weigh belt output, aggregate moisture input, and dry lime meter output, expressed as a percentage of the dry aggregate weight
  - 3.12. Calculated difference between the authorized lime ratio and the actual lime ratio
4. For lime slurry aggregate treatment, a treatment data log from the slurry proportioning device in the following order:
  - 4.1. Treatment date
  - 4.2. Time of day the data is captured
  - 4.3. Aggregate size being treated
  - 4.4. Wet aggregate flow rate collected directly from the aggregate weigh belt

- 4.5. Moisture content of the aggregate just before treatment, expressed as a percentage of the dry aggregate weight
- 4.6. Dry aggregate flow rate calculated from the wet aggregate flow rate
- 4.7. Lime slurry flow rate measured by the slurry meter
- 4.8. Dry lime flow rate calculated from the slurry meter output
- 4.9. Authorized lime ratio for each aggregate size being treated
- 4.10. Actual lime ratio calculated from the aggregate weigh belt and slurry meter output, expressed as a percentage of the dry aggregate weight
- 4.11. Calculated difference between the authorized lime ratio and actual lime ratio
- 4.12. Dry lime and water proportions at the slurry treatment time

Each day during lime treatment, submit the treatment data log on electronic media in tab delimited format. Each continuous treatment data set must be a separate record using a line feed carriage return to present the specified data on 1 line. The reported data must include data titles at least once per report.

### **39-2.01A(3)(h) Warm Mix Asphalt Technology**

If a WMA technology is used, submit the following with your proposed JMF submittal:

1. SDS for the WMA technology
2. For water injection foam technology:
  - 2.1. Name of technology
  - 2.2. Proposed foaming water content
  - 2.3. Proposed HMA production temperature range
  - 2.4. Certification from binder supplier stating no antifoaming agent is used
3. For additive technology:
  - 3.1. Name of technology
  - 3.2. Percent admixture by weight of binder and percent admixture by total weight of HMA as recommended by the manufacturer
  - 3.3. Methodology for inclusion of admixture in laboratory-produced HMA
  - 3.4. Proposed HMA production temperature range

Collect and hold data for the duration of the Contract and submit the electronic media daily. The snapshot of production data must include the following:

1. Production date
2. Production location
3. Time of day the data is captured
4. HMA mix type being produced and target binder rate
5. HMA additive type, brand, and target rate
6. Temperature of the binder and HMA mixture
7. For a continuous mixing plant, the rate of flow of the dry aggregate calculated from the wet aggregate flow rate as determined by the conveyor scale
8. For a continuous mixing plant, the rate of flow of the asphalt meter
9. For a continuous mixing plant, the rate of flow of HMA additive meter
10. For batch plant mixing, actual batch weights of all ingredients
11. Dry aggregate to binder ratio calculated from metered ingredient output
12. Dry aggregate to HMA additive ratio calculated from metered output

At the end of each day's production shift, submit electronic media from the HMA plant process controller. Present data on electronic media in comma-separated values or tab-separated values format. The captured data for the ingredients represented by the production snapshot must have allowances for sufficient fields to satisfy the amount of data required by these specifications and include data titles at least once per report.

### **39-2.01A(3)(i) Reserved**

**39-2.01A(3)(m)–39-2.01A(3)(o) Reserved**

**39-2.01A(4) Quality Assurance**

**39-2.01A(4)(a) General**

AASHTO T 324 (Modified) is AASHTO T 324 with the following parameters:

1. Target air voids must equal  $7.0 \pm 1.0$  percent
2. Specimen height must be  $60 \pm 1$  mm
3. Number of test specimens must be 4 to run 2 tests
4. Do not average the 2 test results
5. Test specimen must be a 150 mm gyratory compacted specimen
6. Test temperature must be set at:
  - 6.1.  $113 \pm 2$  degrees F for PG 58
  - 6.2.  $122 \pm 2$  degrees F for PG 64
  - 6.3.  $131 \pm 2$  degrees F for PG 70 and above
7. Measurements for impression must be taken at every 100 passes along the total length of the sample
8. Inflection point is the number of wheel passes at the intersection of the creep slope and the stripping slope at maximum rut depth
9. Testing shut off must be set at 25,000 passes
10. Submersion time for samples must not exceed 4 hours

Take samples under California Test 125.

If a WMA technology is used, a technical representative for the WMA technology must attend the preconstruction meeting.

**39-2.01A(4)(b) Job Mix Formula Verification**

The Engineer verifies the JMF from samples taken from HMA produced by the plant to be used. The production set point at the plant must be within  $\pm 0.2$  from the asphalt binder percentage TV shown in your Contractor Job Mix Formula Proposal form. Notify the Engineer at least 2 business days before sampling materials. Samples may be taken from a different project including a non-Department project if you make arrangements for the Engineer to be present during sampling.

In the Engineer's presence and from the same production run, take samples of:

1. Aggregates. Coarse, fine, and supplemental fine aggregates must be taken from the combined cold-feed belt or the hot bins. If lime treatment is required, samples must be taken from individual stockpiles before lime treatment. Samples must be at least 120 lb for each coarse aggregate, 80 lb for each fine aggregate, and 10 lb for each type of supplemental fine aggregate. For hot-bin samples, the Department combines these aggregate samples to verify the TV submitted on a Contractor Job Mix Formula Proposal form.
2. Asphalt binder. Take at least four 1 qt samples. Each sample must be in a cylindrical-shaped can with an open top and friction lid. If the asphalt binder is modified or rubberized, the asphalt binder must be sampled with the components blended in the proportions to be used.
3. RAP. Samples must be at least 50 lb from each fractionated stockpile used or 100 lb from the belt.
4. Plant-produced HMA. The HMA samples must be at least 250 lb.

For aggregate, RAP, and HMA, split the samples into at least 4 parts and label their containers.

Submit 3 parts and keep 1 part.

After acceptance of the JMF submittal, the Engineer verifies each proposed JMF within 20 days of receiving all verification samples.

For JMF verification, the Engineer tests the following for compliance with the specifications:

1. Aggregate quality
2. Aggregate gradation
3. Voids in mineral aggregate on laboratory-produced HMA



#### 4. HMA quality characteristics for Department acceptance

To verify the HMA for air voids, voids in mineral aggregate, and dust proportion, the Engineer uses an average of 3 briquettes. The Engineer tests plant-produced material.

If the Engineer verifies the JMF, the Engineer furnishes you a Hot Mix Asphalt Verification form.

If the Engineer's test results on plant-produced samples do not show compliance with the specifications, the Engineer notifies you. Adjust your JMF based on your testing unless the Engineer authorizes reverification without adjustments. JMF adjustments may include a change in:

1. Asphalt binder content TV up to  $\pm 0.20$  percent from the OBC value submitted on the Contractor Hot Mix Asphalt Design Data form
2. Aggregate gradation TV within the TV limits specified in the aggregate gradation table

You may adjust the JMF only once due to a failed verification test.

For each HMA type and aggregate size specified, the Engineer verifies up to 2 proposed JMF submittals including a JMF adjusted after verification failure. If you submit more than 2 JMFs for each type of HMA and aggregate size, the Engineer deducts \$3,000 from payments for each verification exceeding this limit. This deduction does not apply to verifications initiated by the Engineer or if a JMF expires while HMA production is stopped longer than 30 days.

A verified JMF is valid for 12 months.

#### **39-2.01A(4)(c) Job Mix Formula Authorization**

You may start HMA production if:

1. Engineer's review of the JMF shows compliance with the specifications
2. Department has verified the JMF within 12 months before HMA production
3. Engineer authorizes the verified JMF

#### **39-2.01A(4)(d) Job Mix Formula Renewal**

For a JMF renewal and upon request, in the Engineer's presence and from the same production run, take samples of:

1. Aggregates. Coarse, fine, and supplemental fine aggregates must be taken from the combined cold-feed belt or the hot bins. If lime treatment is required, samples must be taken from individual stockpiles before lime treatment. Samples must be at least 120 lb for each coarse aggregate, 80 lb for each fine aggregate, and 10 lb for each type of supplemental fines. For hot-bin samples, the Department combines these aggregate samples to verify the TV submitted on a Contractor Job Mix Formula Proposal form.
2. Asphalt binder. Take at least four 1 qt samples. Each sample must be in a cylindrical-shaped can with an open top and friction lid. If the asphalt binder is modified or rubberized, the asphalt binder must be sampled with the components blended in the proportions to be used.
3. RAP. Samples must be at least 50 lb from each fractionated stockpile.
4. Plant-produced HMA. The HMA samples must be at least 250 lb.

Notify the Engineer at least 2 business days before sampling materials. For aggregate, RAP, and HMA, split samples into at least 4 parts. Submit 3 parts and use 1 part for your testing.

Allow the Engineer 5 business days from a complete JMF reverification submittal for document review of the aggregate qualities, mix design, and JMF.

The most recent aggregate quality test results within the past 12 months may be used for verification of JMF renewal or upon request, the Engineer may perform aggregate quality tests for verification of JMF renewal.

The Engineer verifies the JMF for renewal under section 39-2.01A(4)(b) except:

1. Engineer keeps the samples until you provide test results for your part on a Contractor Job Mix Formula Renewal form.
2. Department tests samples of materials obtained from the HMA production unit after you submit test results that comply with the mix design specifications.
3. After completion of the JMF verification renewal document review, the Engineer verifies each proposed JMF within 20 days of receiving the verification renewal samples and the complete Contractor Job Mix Formula Renewal form.
4. You may not adjust the JMF due to a failed verification.
5. For each HMA type and aggregate gradation specified, the Engineer verifies at no cost to you 1 proposed JMF renewal within a 12-month period.

If the Engineer verifies the JMF renewal, the Engineer furnishes you a Hot Mix Asphalt Verification form. The Hot Mix Asphalt Verification form is valid for 12 months.

**39-2.01A(4)(e) Job Mix Formula Modification**

The Engineer verifies the modified JMF after the modified JMF HMA is placed and verification samples are taken within the first 750 tons. The Engineer tests verification samples for compliance with:

1. Hamburg wheel track mix design specifications
2. Air void content
3. Voids in mineral aggregate on plant-produced HMA mix design specifications
4. Dust proportion mix design specifications

The Engineer may test for moisture susceptibility for compliance with the mix design specifications.

If the modified JMF is verified, the Engineer revises your Hot Mix Asphalt Verification form to include the new asphalt binder source, new liquid antistriper producer, or new liquid antistriper dosage. Your revised form will have the same expiration date as the original form.

If a modified JMF is not verified, stop production and any HMA placed using the modified JMF is rejected.

The Engineer deducts \$2,000 from payments for each JMF modification.

**39-2.01A(4)(f) Certifications**

**39-2.01A(4)(f)(i) General**

Laboratories testing aggregate and HMA qualities used to prepare the mix design and JMF must be qualified under AASHTO Re:Source program and the Caltrans Independent Assurance Program.

**39-2.01A(4)(f)(ii) Hot Mix Asphalt Plants**

Before production, the HMA plant must have a current qualification under the Caltrans Material Plant Quality Program.

**39-2.01A(4)(f)(iii)–39-2.01A(4)(f)(v) Reserved**

**39-2.01A(4)(g) Reserved**

**39-2.01A(4)(h) Quality Control**

**39-2.01A(4)(h)(i) General**

QC test results must comply with the specifications for Department acceptance.

Prepare 3 briquettes for air voids content and voids in mineral aggregate determination. Report the average of 3 tests.

Except for smoothness, if 2 consecutive QC test results or any 3 QC test results for 1 day's production do not comply with the materials specifications:

1. Stop HMA production
2. Notify the Engineer
3. Take corrective action

4. Demonstrate compliance with the specifications before resuming production and placement

For QC tests performed under AASHTO T 27, results are considered 1 QC test regardless of number of sieves out of compliance.

Do not resume production and placement until the Engineer authorizes your corrective action proposal.

You are not entitled to compensation for the suspension of work resulting from noncompliance with quality control requirements, including those identified in the QC Plan.

**39-2.01A(4)(h)(ii) Reserved**

**39-2.01A(4)(h)(iii) Aggregates**

**39-2.01A(4)(h)(iii)(A) General**

Reserved

**39-2.01A(4)(h)(iii)(B) Aggregate Lime Treatments**

If lime treatment is required, sample coarse and fine aggregates from individual stockpiles before lime treatment. Combine aggregate in the JMF proportions. Test the aggregates under the test methods and frequencies shown in the following table:

**Aggregate Quality Control During Lime Treatment**

Quality characteristic	Test method	Minimum sampling and testing frequency
Sand equivalent <sup>a, b</sup>	AASHTO T 176	1 per 750 tons of untreated aggregate
Percent of crushed particles	AASHTO T 335	1 per 10,000 tons or 2 per project whichever is greater
Los Angeles Rattler	AASHTO T 96	
Fine aggregate angularity	AASHTO T 304, Method A	
Flat and elongated particles	ASTM D4791	
Fine durability index	AASHTO T 210	

<sup>a</sup>Report test results as the average of 3 tests from a single sample.

<sup>b</sup>Use of a sand reading indicator is required as shown in AASHTO T 176, Figure 1. Sections 4.7, "Manual Shaker," 7.1.2, "Alternate Method No. 2," 8.4.2, "Manual Shaker Method, and 8.4.3, "Hand Method," do not apply. Prepare the stock solution as specified in section 4.8.1, "Stock solution with formaldehyde," except omit the addition of formaldehyde.

For lime slurry aggregate treatment, determine the aggregate moisture content at least once every 2 hours of treatment. Calculate moisture content under AASHTO T 255 and report it as a percent of dry aggregate weight. Use the moisture content calculations as a set point for the proportioning process controller.

The device controlling lime and aggregate proportioning must produce a treatment data log. The log must consist of a series of data sets captured at 10-minute intervals throughout daily treatment. The data must be a treatment activity register and not a summation. The material represented by a data set is the quantity produced 5 minutes before and 5 minutes after the capture time. Collected data must be stored by the controller for the duration of the Contract.

If 3 consecutive sets of recorded treatment data indicate a deviation of more than 0.2 percent above or below the lime ratio in the authorized JMF, stop treatment and take corrective action.

If a set of recorded treatment data indicates a deviation of more than 0.4 percent above or below the lime ratio in the authorized JMF, stop treatment and do not use the material represented by that set of data in HMA.

If 20 percent or more of the total daily treatment indicates a deviation of more than 0.2 percent above or below the lime ratio in the authorized JMF, stop treatment and do not use that day's treated aggregate in HMA.

The Engineer may order you to stop aggregate treatment activities for any of following:

1. You fail to submit treatment data log.
2. You fail to submit aggregate QC data for marinated aggregate.
3. You submit incomplete, untimely, or incorrectly formatted data.
4. You do not take corrective actions.
5. You take late or unsuccessful corrective actions.
6. You do not stop treatment when proportioning tolerances are exceeded.
7. You use malfunctioning or failed proportioning devices.

If you stop treatment for noncompliance, notify the Engineer of any corrective actions taken and conduct a successful 20-minute test run before resuming treatment.

#### **39-2.01A(4)(h)(iv) Liquid Antistrip Treatment**

For continuous mixing or batch-plant mixing, sample asphalt binder before adding liquid antistrip. For continuous mixing, sample the combined asphalt binder and liquid antistrip after the static mixer.

#### **39-2.01A(4)(h)(v) Production Start-up Evaluation**

You and the Engineer evaluate HMA production and placement at production start-up.

Within the first 750 tons produced on the 1st day of HMA production, in the Engineer's presence, and from the same production run, take samples of:

1. Aggregates. Samples must be at least 120 lb for each coarse aggregate, 80 lb for each fine aggregate, and 10 lb for each type of supplemental fines. For hot-bin samples, the Department combines these aggregate samples.
2. Asphalt binder. Take at least four 1 qt samples. Each sample must be in a cylindrical-shaped can with an open top and friction lid. If the asphalt binder is modified or rubberized, the asphalt binder must be sampled with the components blended in the proportions to be used.
3. RAP. Samples must be at least 50 lb..
4. HMA. The HMA samples must be at least 250 lb.

Sample aggregates from the combined cold-feed belt or hot bin. Take RAP samples from the RAP system.

For aggregates, RAP, and HMA, split the samples into at least 4 parts and label their containers. Submit 3 parts and keep 1 part.

You and the Engineer must test the samples and report test results, except for AASHTO T 324 (Modified) and AASHTO T 283 test results, within 5 business days of sampling. For AASHTO T 324 (Modified) and AASHTO T 283 test results, report test results within 15 days of sampling. If you proceed before receipt of the test results, the Engineer may consider the HMA placed to be represented by these test results.

#### **39-2.01A(4)(h)(vi) RESERVED**

#### **39-2.01A(4)(h)(vii) RESERVED**

### **39-2.01A(4)(h)(viii) Density Cores**

Except for HMA pavement placed using method compaction, take 4- or 6-inch diameter density cores at least once every 5 business days. Take 1 density core for every 250 tons of HMA from random locations the Engineer selects. Take density cores in the Engineer's presence, and backfill and compact holes with authorized material. Before submitting a density core, mark it with the density core's location and place it in a protective container.

If a density core is damaged, replace it with a density core taken within 1 foot longitudinally from the original density core location. Relocate any density core located within 1 foot of a rumble strip to 1 foot transversely away from the rumble strip.

For a tapered notched wedge joint, take 4- or 6-inch diameter density cores 6 inches from the upper vertical notch of the completed longitudinal joint for every 3,000 feet at locations selected by the Engineer. Take cores after the adjacent lane is placed and before opening the pavement to traffic. Take cores in the presence of the Engineer, and backfill and compact holes with authorized material. Before submitting a density core, mark it with the core's location, and place it in a protective container.

### **39-2.01A(4)(h)(ix) Pavement Smoothness**

For HMA pavement within 3 feet from and parallel to the construction joint formed between curbs, gutters, or existing pavement, test pavement smoothness using a 12-foot straightedge.

### **39-2.01A(4)(h)(x) Reserved**

#### **39-2.01A(4)(i) Department Acceptance**

##### **39-2.01A(4)(i)(i) General**

The Department tests treated aggregate for acceptance before lime treatment except for gradation.

The Engineer takes HMA samples for AASHTO T 283 and AASHTO T 324 (Modified) from any of the following locations:

1. Plant
2. Truck
3. Windrow

The Engineer takes HMA samples for all other tests from any of the following locations:

1. Plant
2. Truck
3. Windrow
4. Mat behind the paver

To obtain workability of the HMA sample for splitting, the Engineer reheats each sample of HMA mixture not more than 2 cycles. Each reheat cycle is performed by placing the loose mixture in a mechanical forced-draft oven for 2 hours or less after the sample reaches 140 degrees F.

The Engineer splits samples and provides you with a part if you request this.

No single aggregate or HMA test result may represent more than 750 tons or one day's production, whichever is less, except AASHTO T 283 and AASHTO T 324 (Modified).

Except for smoothness, if 2 consecutive Department acceptance test results or any 3 Department acceptance test results for 1 day's production do not comply with the specifications:

1. Stop HMA production
2. Take corrective action
3. Demonstrate compliance with the specifications before resuming production and placement

For Department acceptance tests performed under AASHTO T 27, results are considered 1 Department acceptance test regardless of the number of sieves out of compliance.

The Engineer accepts HMA based on:

1. Authorized JMF
2. Authorized QC plan
3. Asphalt binder compliance
4. Asphalt emulsion compliance
5. Visual inspection
6. Pavement smoothness

**39-2.01A(4)(i)(ii) In-Place Density**

Except for HMA pavement placed using method compaction, the Engineer tests the density core you take from each 250 tons of HMA. The Engineer determines the percent of theoretical maximum density for each density core by determining the density core's density and dividing by the theoretical maximum density.

Density cores must be taken from the final layer, cored through the entire pavement thickness shown. Where OGFC is required, take the density cores before placing OGFC.

If the percent of theoretical maximum density does not comply with the specifications, the Engineer may accept the HMA and take a payment deduction as shown in the following table:

**Reduced Payment Factors for Percent of Maximum Theoretical Density**

HMA percent of maximum theoretical density	Reduced payment factor	HMA percent of maximum theoretical density	Reduced payment factor
91.0	0.0000	97.0	0.0000
90.9	0.0125	97.1	0.0125
90.8	0.0250	97.2	0.0250
90.7	0.0375	97.3	0.0375
90.6	0.0500	97.4	0.0500
90.5	0.0625	97.5	0.0625
90.4	0.0750	97.6	0.0750
90.3	0.0875	97.7	0.0875
90.2	0.1000	97.8	0.1000
90.1	0.1125	97.9	0.1125
90.0	0.1250	98.0	0.1250
89.9	0.1375	98.1	0.1375
89.8	0.1500	98.2	0.1500
89.7	0.1625	98.3	0.1625
89.6	0.1750	98.4	0.1750
89.5	0.1875	98.5	0.1875
89.4	0.2000	98.6	0.2000
89.3	0.2125	98.7	0.2125
89.2	0.2250	98.8	0.2250
89.1	0.2375	98.9	0.2375
89.0	0.2500	99.0	0.2500
<89.0	Remove and replace	>99.0	Remove and replace

For acceptance of a completed tapered notched wedge joint, the Engineer determines density from cores you take every 3,000 feet.

**39-2.01A(4)(i)(iii) Pavement Smoothness**

RESERVED

### **39-2.01A(4)(i)(iv) Dispute Resolution**

You and the Engineer must work together to avoid potential conflicts and to resolve disputes regarding test result discrepancies. Notify the Engineer within 5 business days of receiving a test result if you dispute the test result.

If you or the Engineer dispute the other's test results, submit your test results and copies of paperwork including worksheets used to determine the disputed test results. An independent third party performs referee testing. Before the third party participates in a dispute resolution, it must be qualified under AASHTO Materials Reference Laboratory program, and the Caltrans' Independent Assurance Program. The independent third party must have no prior direct involvement with this Contract. By mutual agreement, the independent third party is chosen from:

1. Caltrans laboratory in a district or region not in the district or region the project is located
2. Transportation Laboratory
3. Laboratory not currently employed by you or your HMA producer

If the Department's portion of the split QC samples or acceptance samples are not available, the independent third party uses any available material representing the disputed HMA for evaluation.

For a dispute involving JMF verification, the independent third party performs referee testing as specified in the 5th paragraph of section 39-2.01A(4)(b).

If the independent third party determines the Department's test results are valid, the Engineer deducts the independent third party's testing costs from payments. If the independent third party determines your test results are valid, the Department pays the independent third party's testing costs.

### **39-2.01B Materials**

#### **39-2.01B(1) General**

Reserved

#### **39-2.01B(2) Mix Design**

##### **39-2.01B(2)(a) General**

The HMA mix design must comply with the Superpave HMA mix design as described in MS-2 Asphalt Mix Design Methods by the Asphalt Institute.

The Contractor Hot Mix Asphalt Design Data form must show documentation on aggregate quality.

##### **39-2.01B(2)(b) Hot Mix Asphalt Treatments**

If the proposed JMF indicates that the aggregate is being treated with dry lime or lime slurry with marination, or the HMA with liquid antistripping, then testing the untreated aggregate under AASHTO T 283 and AASHTO T 324 is not required.

If HMA treatment is required or being used by the Contractor, determine the plasticity index of the aggregate blend under California Test 204.

Do not use an aggregate blend with a plasticity index greater than 10.

If the plasticity index is from 4 to 10, treat the aggregate blend with dry lime with marination or lime slurry with marination.

If the plasticity index is less than 4, treat the aggregate blend with dry lime or lime slurry with marination, or treat the HMA with liquid antistripping.

##### **39-2.01B(2)(c) Warm Mix Asphalt Technology**

For HMA with WMA additive technology, produce HMA mix samples for your mix design using your methodology for inclusion of WMA admixture in laboratory-produced HMA. Cure the samples in a forced-air draft oven at 275 degrees F for 4 hours  $\pm$  10 minutes.

For WMA water injection foam technology, the use of foamed asphalt for mix design is not required.

**39-2.01B(3) Asphalt Binder**

Asphalt binder must comply with section 92.

For a leveling course, the grade of asphalt binder for the HMA must be PG 64-10 or PG 64-16.

**39-2.01B(4) Aggregates**

**39-2.01B(4)(a) General**

Aggregates must be clean and free from deleterious substances.

The aggregates for a leveling course must comply with the grading specifications for Type A HMA in section 39-2.02B(4)(b).

**39-2.01B(4)(b) Aggregate Gradations**

Aggregate gradation must be determined before the addition of asphalt binder and must include supplemental fine aggregates. Test for aggregate gradation under AASHTO T 27. Do not wash the coarse aggregate. Wash the fine aggregate only. Use a mechanical sieve shaker. Aggregate shaking time must not exceed 10 minutes for each coarse and fine aggregate portion.

Choose a TV within the TV limits shown in the tables titles “Aggregate Gradation for Type A HMA (Percentage Passing)”.

Gradations are based on nominal maximum aggregate size.

**39-2.01B(4)(c) Aggregate Lime Treatments**

**39-2.01B(4)(c)(i) General**

If aggregate lime treatment is required as specified in section 39-2.01B(2)(b), the virgin aggregate must comply with the aggregate quality specifications.

Lime for treating aggregate must comply with section 24-2.02.

Water for lime treatment of aggregate with lime slurry must comply with section 24-1.02B.

Notify the Engineer at least 24 hours before the start of aggregate treatment.

Do not treat RAP.

The lime ratio is the pounds of dry lime per 100 lb of dry virgin aggregate expressed as a percentage. Water content of slurry or untreated aggregate must not affect the lime ratio.

Coarse and fine aggregate fractions must have the lime ratio ranges shown in the following table:

Aggregate fractions	Lime ratio percent
Coarse	0.4–1.0
Fine	1.5–2.0
Combined	0.8–1.5

The lime ratio for fine and coarse aggregate must be within  $\pm 0.2$  percent of the lime ratio in the accepted JMF. The lime ratio must be within  $\pm 0.2$  percent of the authorized lime ratio when you combine the individual aggregate sizes in the JMF proportions. The lime ratio must be determined before the addition of RAP.

If marination is required, marinate treated aggregate in stockpiles from 24 hours to 60 days before using in HMA. Do not use aggregate marinated longer than 60 days.

Treated aggregate must not have lime balls or clods.



### **39-2.01B(4)(c)(ii) Dry Lime**

If marination is required:

1. Treat and marinate coarse and fine aggregates separately
2. Treat the aggregate and stockpile for marination only once
3. Treat the aggregate separately from HMA production

Proportion dry lime by weight with an automatic continuous proportioning system.

If you use a batch-type proportioning system for HMA production, control proportioning in compliance with the specifications for continuous mixing plants. Use a separate dry lime aggregate treatment system for HMA batch mixing including:

1. Pugmill mixer
2. Controller
3. Weigh belt for the lime
4. Weigh belt for the aggregate

If a continuous mixing plant for HMA production without lime-marinated aggregates is used, use a controller that measures the blended aggregate weight after any additional water is added to the mixture. The controller must determine the quantity of lime added to the aggregate from the aggregate weigh belt input in connection with the manually input total aggregate moisture, the manually input target lime content, and the lime proportioning system output. Use a continuous aggregate weigh belt and pugmill mixer for lime treatment in addition to the weigh belt for the aggregate proportioning to asphalt binder in the HMA plant. If you use a water meter for moisture control for lime treatment, the meter must comply with Caltrans' *MPQP* manual.

When mixing dry lime with aggregate, the aggregate moisture content must ensure complete lime coating. The aggregate moisture content must not cause aggregate to be lost between the point of weighing the combined aggregate continuous stream and the dryer. Add water to the aggregate for mixing and coating before dry lime addition. Immediately before mixing lime with aggregate, water must not visibly separate from the aggregate.

Mix aggregate, water, and dry lime with a continuous pugmill mixer with twin shafts. Immediately before mixing lime with aggregate, water must not visibly separate from the aggregate. Store dry lime in a uniform and free-flowing condition. Introduce dry lime to the pugmill in a continuous process. The introduction must occur after the aggregate cold feed and before the point of proportioning across a weigh belt and the aggregate dryer. Prevent loss of dry lime.

The pugmill must be equipped with paddles arranged to provide sufficient mixing action and mixture movement. The pugmill must produce a homogeneous mixture of uniformly coated aggregates at mixer discharge.

If the aggregate treatment process is stopped longer than 1 hour, clean the equipment of partially treated aggregate and lime.

Aggregate must be completely treated before introduction into the mixing drum.

### **39-2.01B(4)(c)(iii) Lime Slurry**

For lime slurry aggregate treatment, treat aggregate separate from HMA production. Stockpile and marinate the aggregate.

Proportion lime and water with a continuous or batch mixing system.

Add lime to the aggregate as slurry consisting of mixed dry lime and water at a ratio of 1 part lime to from 2 to 3 parts water by weight. The slurry must completely coat the aggregate.

Immediately before mixing lime slurry with the aggregate, water must not visibly separate from the aggregate.

Proportion lime slurry and aggregate by weight in a continuous process.

**39-2.01B(5) Liquid Antistrip Treatment**

Liquid antistrip must be from 0.25 to 1.0 percent by weight of asphalt binder. Do not use liquid antistrip as a substitute for asphalt binder.

Liquid antistrip total amine value must be 325 minimum when tested under ASTM D2074.

Use only 1 liquid antistrip type or brand at a time. Do not mix liquid antistrip types or brands.

Store and mix liquid antistrip under the manufacturer's instructions.

**39-2.01B(6)–39-2.01B(7) Reserved**

**39-2.01B(8) Hot Mix Asphalt Production**

**39-2.01B(8)(a) General**

Do not start HMA production before verification and authorization of JMF.

The HMA plant must have a current qualification under Caltrans' Material Plant Quality Program.

Weighing and metering devices used for the production of HMA modified with additives must comply with Caltrans' *MPQP*. If a loss-in-weight meter is used for dry HMA additive, the meter must have an automatic and integral material delivery control system for the refill cycle.

Calibrate the loss-in-weight meter by:

1. Including at least 1 complete system refill cycle during each calibration test run
2. Operating the device in a normal run mode for 10 minutes immediately before starting the calibration process
3. Isolating the scale system within the loss-in-weight feeder from surrounding vibration
4. Checking the scale system within the loss-in-weight feeder for accuracy before and after the calibration process and daily during mix production
5. Using a minimum 15 minute or minimum 250 lb test run size for a dry ingredient delivery rate of less than 1 ton per hour.
6. Complying with the limits of Table B, "Conveyor Scale Testing Extremes," in Caltrans' *MPQP*

Proportion aggregate by hot or cold-feed control.

Aggregate temperature must not be more than 375 degrees F when mixed with the asphalt binder.

Asphalt binder temperature must be from 275 to 375 degrees F when mixed with aggregate.

Mix HMA ingredients into a homogeneous mixture of coated aggregates.

HMA must be produced at the temperatures shown in the following table:

<b>HMA Production Temperatures</b>	
HMA compaction	Temperature (°F)
HMA	
Density based	≤ 325
Method	305–325
HMA with WMA technology	
Density based	240–325
Method	260–325

If you stop production for longer than 30 days, a production start-up evaluation is required.

**39-2.01B(8)(b) Liquid Antistrip**

If 3 consecutive sets of recorded production data show that the actual delivered liquid antistrip weight is more than ±1 percent of the authorized mix design liquid antistrip weight, stop production and take corrective action.

If a set of recorded production data shows that the actual delivered liquid antistriper weight is more than  $\pm 2$  percent of the authorized mix design liquid antistriper weight, stop production. If the liquid antistriper weight exceeds 1.2 percent of the asphalt binder weight, do not use the HMA represented by that data.

The continuous mixing plant controller proportioning the HMA must produce a production data log. The log must consist of a series of data sets captured at 10-minute intervals throughout daily production. The data must be a production activity register and not a summation. The material represented by the data is the quantity produced 5 minutes before and 5 minutes after the capture time. For the duration of the Contract, the collected data must be stored by the plant controller or a computer's memory at the plant.

The Engineer orders proportioning activities stopped for any of the following reasons:

1. You fail to submit data
2. You submit incomplete, untimely, or incorrectly formatted data
3. You fail to take corrective actions
4. You take late or unsuccessful corrective actions
5. You fail to stop production when proportioning tolerances are exceeded
6. You use malfunctioning or failed proportioning devices

If you stop production, notify the Engineer of any corrective actions taken before resuming.

### **39-2.01B(8)(c) Warm Mix Asphalt Technology**

Proportion all ingredients by weight. The HMA plant process controller must be the sole source of ingredient proportioning control and be fully interfaced with all scales and meters used in the production process. The addition of the HMA additive must be controlled by the plant process controller.

Liquid ingredient additive, including a normally dry ingredient made liquid, must be proportioned with a mass flow meter at continuous mixing plants. Use a mass flow meter or a container scale to proportion liquid additives at batch mixing plants.

Continuous mixing plants using HMA additives must comply with the following:

1. Dry ingredient additives for continuous production must be proportioned with a conveyor scale or a loss-in-weight meter.
2. HMA plant process controller and ingredient measuring systems must be capable of varying all ingredient-feed rates proportionate with the dry aggregate delivery at all production rates and rate changes.
3. Liquid HMA additive must enter the production stream with the binder. Dry HMA additive must enter the production stream at or before the mixing area.
4. If dry HMA additives are used at continuous mixing HMA plants, bag-house dust systems must return all captured material to the mix. This requirement is waived for lime-treated aggregates.
5. HMA additive must be proportioned to within  $\pm 0.3$  percent of the target additive rate.

Batch mixing plants using HMA additives must comply with the following:

1. Metered HMA additive must be placed in an intermediate holding vessel before being added to the stream of asphalt binder as it enters the pugmill.
2. If a container scale is used, weigh additive before combining with asphalt binder. Keep the container scale separate from other ingredient proportioning. The container scale capacity must be no more than twice the volume of the maximum additive batch size. The container scale's graduations must be smaller than the proportioning tolerance or 0.001 times the container scale capacity.
3. Dry HMA additive proportioning devices must be separate from metering devices for the aggregates and asphalt binder. Proportion dry HMA additive directly into the pugmill, or place in an intermediate holding vessel to be added to the pugmill at the appropriate time in the batch cycle. Dry ingredients for batch production must be proportioned with a hopper scale.
4. Zero tolerance for the HMA additive batch scale is  $\pm 0.5$  percent of the target additive weight. The indicated HMA additive batch scale weight may vary from the preselected weight setting by up to  $\pm 1.0$  percent of the target additive weight.

### 39-2.01B(9) Geosynthetic Pavement Interlayer

Geosynthetic pavement interlayer must comply with the specifications for pavement fabric, paving mat, paving grid, paving geocomposite grid, or geocomposite strip membrane as shown.

The asphalt binder for geosynthetic pavement interlayer must be PG 64-10, PG 64-16, or PG 70-10.

### 39-2.01B(10) Tack Coat

Tack coat must comply with the specifications for asphaltic emulsion or asphalt binder. Choose the type and grade of emulsion or binder.

### 39-2.01B(11) Miscellaneous Areas and Dikes

For miscellaneous areas and dikes:

1. Choose the aggregate gradation from:
  - 1.1. 3/8-inch Type A HMA aggregate gradation
  - 1.2. 1/2-inch Type A HMA aggregate gradation
  - 1.3. dike mix aggregate gradation
2. Choose asphalt binder Grade PG 64-10, PG 64-16 or PG 70-10.
3. Minimum asphalt binder content must be:
  - 3.1. 6.40 percent for 3/8-inch Type A HMA aggregate gradation
  - 3.2. 5.70 percent for 1/2-inch Type A HMA aggregate gradation
  - 3.3. 6.00 percent for dike mix aggregate gradation

If you request and the Engineer authorizes, you may reduce the minimum asphalt binder content.

Aggregate gradation for dike mix must be within the TV limits for the specified sieve size shown in the following table:

**Dike Mix Aggregate Gradation  
(Percentage Passing)**

Sieve size	Target value limit	Allowable tolerance
1/2"	100	--
3/8"	---	95 - 100
No. 4	73-77	TV ± 10
No. 8	58-63	TV ± 10
No. 30	29-34	TV ± 10
No. 200		0 - 14

For HMA used in miscellaneous areas and dikes, sections 39-2.01A(3), 39-2.01A(4), 39-2.01B(2), 39-2.01B(4)(c), and 39-2.01B(5)-(10) do not apply.

### 39-2.01C Construction

#### 39-2.01C(1) General

Do not place HMA on wet pavement or frozen surface.

You may deposit HMA in a windrow and load it in the paver if:

1. Paver is equipped with a hopper that automatically feeds the screed
2. Loading equipment can pick up the windrowed material and deposit it in the paver hopper without damaging base material
3. Activities for depositing, pickup, loading, and paving are continuous
4. For method compaction:
  - 4.1. The temperature of the HMA and the HMA produced with WMA water injection technology in the windrow does not fall below 260 degrees F

- 4.2. The temperature of the HMA produced using WMA additive technology in the windrow does not fall below 250 degrees F

HMA placed in a windrow on the roadway surface must not extend more than 250 feet in front of the loading equipment or material transfer vehicle.

You may place HMA in 1 or more layers on areas less than 5 feet wide and outside the traveled way, including shoulders. You may use mechanical equipment other than a paver for these areas. The equipment must produce uniform smoothness and texture.

HMA handled, spread, or windrowed must not stain the finished surface of any improvement, including pavement.

Do not use petroleum products such as kerosene or diesel fuel to release HMA from trucks, spreaders, or compactors.

HMA must be free of:

1. Segregation
2. Coarse or fine aggregate pockets
3. Hardened lumps
4. Marks
5. Tearing
6. Irregular Texture

Complete finish rolling activities before the pavement surface temperature is:

1. Below 150 degrees F for HMA with unmodified binder
2. Below 140 degrees F for HMA with modified binder

### **39-2.01C(2) Spreading and Compacting Equipment**

#### **39-2.01C(2)(a) General**

Paving equipment for spreading must be:

1. Self-propelled
2. Mechanical
3. Equipped with a screed or strike-off assembly that can distribute HMA the full width of a traffic lane
4. Equipped with a full-width compacting device
5. Equipped with automatic screed controls and sensing devices that control the thickness, longitudinal grade, and transverse screed slope

Install and maintain grade and slope references.

The screed must be heated and produce a uniform HMA surface texture without tearing, shoving, or gouging.

The paver must not leave marks such as ridges and indentations unless you can eliminate them by rolling.

Rollers must be equipped with a system that prevents HMA from sticking to the wheels. You may use a parting agent that does not damage the HMA or impede the bonding of layers.

In areas inaccessible to spreading and compacting equipment:

1. Spread the HMA by any means to obtain the specified lines, grades, and cross sections
2. Use a pneumatic tamper, plate compactor, or equivalent to achieve thorough compaction

### **39-2.01C(2)(b) Material Transfer Vehicle**

If a material transfer vehicle is specified, the material transfer vehicle must have sufficient capacity to prevent stopping the paver and must be capable of:

1. Either receiving HMA directly from trucks or using a windrow pickup head to load it from a windrow deposited on the roadway surface
2. Remixing the HMA with augers before transferring into the paver's receiving hopper or feed system
3. Transferring HMA directly into the paver's receiving hopper or feed system

### **39-2.01C(2)(c) Method Compaction Equipment**

For method compaction, each paver spreading HMA must be followed by at least one of each of the following 3 types of rollers:

1. Breakdown roller must be a vibratory roller specifically designed to compact HMA. The roller must be capable of at least 2,500 vibrations per minute and must be equipped with amplitude and frequency controls. The roller's gross static weight must be at least 7.5 tons.
2. Intermediate roller must be an oscillating-type pneumatic-tired roller at least 4 feet wide. Pneumatic tires must be of equal size, diameter, type, and ply. The tires must be inflated to 60 psi minimum and maintained so that the air pressure does not vary more than 5 psi.
3. Finishing roller must be a steel-tired, 2-axle tandem roller. The roller's gross static weight must be at least 7.5 tons.

Each roller must have a separate operator. Rollers must be self-propelled and reversible.

### **39-2.01C(2)(d)–39-2.01C(2)(f) Reserved**

### **39-2.01C(3) Surface Preparation**

#### **39-2.01C(3)(a) General**

Before placing HMA, remove loose paving particles, dirt, and other extraneous material by any means including flushing and sweeping.

#### **39-2.01C(3)(b) Subgrade**

Prepare subgrade to receive HMA under the sections for the material involved. Subgrade must be free of loose and extraneous material.

#### **39-2.01C(3)(c) Reserved**

#### **39-2.01C(3)(d) Reserved**

#### **39-2.01C(3)(e) Reserved**

#### **39-2.01C(3)(f) Tack Coat**

Apply a tack coat:

1. To existing pavement including planed surfaces
2. Between HMA layers
3. To vertical surfaces of:
  - 3.1. Curbs
  - 3.2. Gutters
  - 3.3. Construction joints

Equipment for the application of tack coat must comply with section 37-1.03B.

Before placing HMA, apply a tack coat in 1 application at the minimum residual rate shown in the following table for the condition of the underlying surface:

**Tack Coat Application Rates for HMA**

HMA over:	Minimum residual rates (gal/sq yd)		
	CSS1/CSS1h, SS1/SS1h and QS1h/CQS1h asphaltic emulsion	CRS1/CRS2, RS1/RS2 and QS1/CQS1 asphaltic emulsion	Asphalt binder and PMRS2/PMCRS2 and PMRS2h/PMCRS2h asphaltic emulsion
New HMA (between layers)	0.02	0.03	0.02
Concrete pavement and existing asphalt concrete surfacing	0.03	0.04	0.03
Planed pavement	0.05	0.06	0.04

If a stress absorbing membrane interlayer as specified in section 37-2.05 is applied, the tack coat application rates for new HMA apply.

Notify the Engineer if you dilute asphaltic emulsion with water. The weight ratio of added water to asphaltic emulsion must not exceed 1 to 1.

Measure added water either by weight or volume under section 9-1.02 or use water meters from water districts, cities, or counties. If you measure water by volume, apply a conversion factor to determine the correct weight.

With each dilution, submit:

1. Weight ratio of water to bituminous material in the original asphaltic emulsion
2. Weight of asphaltic emulsion before diluting
3. Weight of added water
4. Final dilution weight ratio of water to asphaltic emulsion

Apply a tack coat to vertical surfaces with a residual rate that will thoroughly coat the vertical face without running off.

If authorized, you may:

1. Change tack coat rates
2. Omit tack coat between layers of new HMA during the same work shift if:
  - 2.1. No dust, dirt, or extraneous material is present
  - 2.2. Surface is at least 140 degrees F

Immediately in advance of placing HMA, apply additional tack coat to damaged areas or where loose or extraneous material is removed.

Close areas receiving tack coat to traffic. Do not allow the tracking of tack coat onto pavement surfaces beyond the job site.

If you use an asphalt binder for tack coat, the asphalt binder temperature must be from 285 to 350 degrees F when applied.

**39-2.01C(3)(g) Geosynthetic Pavement Interlayer**

Where shown, place geosynthetic pavement interlayer over a coat of asphalt binder and in compliance with the manufacturer's instructions. Do not place the interlayer on a wet or frozen surface. If the interlayer, in compliance with the manufacturer's instructions, does not require asphalt binder, do not apply asphalt binder before placing the interlayer.

Before placing the interlayer or asphalt binder:

1. Repair cracks 1/4 inch and wider, spalls, and holes in the pavement. This repair is change order work.
2. Clean the pavement of loose and extraneous material.

If the interlayer requires asphalt binder, immediately before placing the interlayer, apply asphalt binder at a rate specified by the interlayer manufacturer; at  $0.25 \pm 0.03$  gal per square yard of interlayer; or at a rate that just saturates the interlayer; whichever is greater. Apply asphalt binder the width of the interlayer plus 3 inches on each side. At an interlayer overlap, apply asphalt binder on the lower interlayer the same overlap distance as the upper interlayer.

If asphalt binder tracked onto the interlayer or brought to the surface by construction equipment causes interlayer displacement, cover it with a small quantity of HMA.

If the interlayer placement does not require asphalt binder, apply tack coat prior to placing HMA at the application rates specified under section 39-2.01C(3)(f) based on the condition of the underlying surface on which the interlayer was placed.

Align and place the interlayer with no overlapping wrinkles, except a wrinkle that overlaps may remain if it is less than 1/2 inch thick. If the overlapping wrinkle is more than 1/2 inch thick, cut the wrinkle out and overlap the interlayer no more than 2 inches.

Overlap the interlayer borders between 2 to 4 inches. In the direction of paving, overlap the following roll with the preceding roll at any break.

You may use rolling equipment to correct distortions or wrinkles in the interlayer.

Before placing HMA on the interlayer, do not expose the interlayer to:

1. Traffic, except for crossings under traffic control and only after you place a small HMA quantity
2. Sharp turns from construction equipment
3. Damaging elements

Pave HMA on the interlayer during the same work shift. The minimum HMA thickness over the interlayer must be 0.12 foot including at conform tapers.

### **39-2.01C(4) Longitudinal Joints**

#### **39-2.01C(4)(a) General**

Longitudinal joints in the top layer must match lane lines. Alternate the longitudinal joint offsets in the lower layers at least 0.5 foot from each side of the lane line. Other longitudinal joint placement patterns are allowed if authorized.

A vertical longitudinal joint of more than 0.15 foot is not allowed at any time between adjacent lanes open to traffic.

For an HMA thickness of 0.15 foot or less, the distance between the ends of the adjacent surfaced lanes at the end of each day's work must not be greater than can be completed in the following day of normal paving.

For an HMA thickness greater than 0.15 foot, you must place HMA on adjacent traveled way lanes or shoulder such that at the end of each work shift the distance between the ends of HMA layers on adjacent lanes is from 5 to 10 feet. Place additional HMA along the transverse edge at each lane's end and along the exposed longitudinal edges between adjacent lanes. Hand rake and compact the additional HMA to form temporary conforms. You may place kraft paper or other authorized release agent under the conform tapers to facilitate the taper removal when paving activities resume.

If placing HMA against the edge of existing pavement, saw cut or grind the pavement straight and vertical along the joint and remove extraneous material.



### **39-2.01C(4)(b) Tapered Notched Wedge**

For divided highways with an HMA lift thickness greater than 0.15 foot, you may construct a 1-foot wide tapered notched wedge joint as a longitudinal joint between adjacent lanes open to traffic. A vertical notch of 0.75 inch maximum must be placed at the top and bottom of the tapered wedge.

The tapered notched wedge must keep its shape while exposed to traffic. Pave the adjacent lane within 1 day.

Construct the tapered portion of the tapered notched wedge with an authorized strike-off device. The strike-off device must provide a uniform slope and must not restrict the main screed of the paver.

You may use a device attached to the screed to construct longitudinal joints that will form a tapered notched wedge in a single pass. The tapered notched wedge must be compacted to a minimum of 91 percent compaction.

### **39-2.01C(5) Pavement Edge Treatments**

Construct edge treatment on the HMA pavement as shown.

Where a tapered edge is required, use the same type of HMA used for the adjacent lane or shoulder.

The edge of roadway where the tapered edge is to be placed must have a solid base, free of debris such as loose material, grass, weeds, or mud. Grade the areas to receive the tapered edge as required.

The tapered edge must be placed monolithic with the adjacent lane or shoulder and must be shaped and compacted with a device attached to the paver.

The device must be capable of shaping and compacting HMA to the required cross section as shown. Compaction must be accomplished by constraining the HMA to reduce the cross sectional area by 10 to 15 percent. The device must produce a uniform surface texture without tearing, shoving, or gouging and must not leave marks such as ridges and indentations. The device must be capable of transitioning to cross roads, driveways, and obstructions.

For the tapered edge, the angle of the slope must not deviate by more than  $\pm 5$  degrees from the angle shown. Measure the angle from the plane of the adjacent finished pavement surface.

If paving is done in multiple lifts, the tapered edge must be placed with each lift.

Short sections of hand work are allowed to construct tapered edge transitions.

The test section:

1. Must not be less than 0.1 mile in length.
2. Must have a width equal to the width of the pavement and tapered edge to be paved in one pass during production.
3. Locations shall be proposed by the Contractor and approved by the Engineer.

The test section must be constructed with asphalt paver fitted with one of the following FHWA-approved tapered edge devices:

1. **“Shoulder Wedge Maker”** manufactured by Transtech Systems, Inc., 1594 State Street, Schenectady, NY 12304, Telephone 1-800-724-6306 or 518-370-5558
2. **“Advant-Edger”** manufactured by Advant-Edge Paving Equipment LLC, 33 Old Niskayuna Road, Loudonville, NY 12211, Telephone 814-422-3343
3. **“Ramp Champ”** manufactured by Advant-Edge Paving Equipment LLC, 33 Old Niskayuna Road, Loudonville, NY 12211, Telephone 814-422-3343
4. **“SafeTSlope”** manufactured by Troxler Electronic Laboratories, Inc., 3008 E. Cornwallis Rd. Research Triangle Park, NC 27709, Telephone 877-876-9537

Comply with manufacturer's instructions for attaching the device(s) to the paver. The Engineer accepts the use of selected tapered edge device when edge shape and compaction of the test section are in compliance with plans and specifications. No further paving operations which include the construction of the tapered edge shall commence unless means and methods for constructing the tapered edge are approved by the Engineer.

### **39-2.01C(6) Widening Existing Pavement**

If widening existing pavement, construct new pavement structure to match the elevation of the existing pavement's edge before placing HMA over the existing pavement.

### **39-2.01C(7) Shoulders, Medians, and Other Road Connections**

Until the adjoining through lane's top layer has been paved, do not pave the top layer of:

1. Shoulders
2. Tapers
3. Transitions
4. Road connections
5. Driveways
6. Curve widenings
7. Chain control lanes
8. Turnouts
9. Turn pockets

If the number of lanes changes, pave each through lane's top layer before paving a tapering lane's top layer. Simultaneous to paving a through lane's top layer, you may pave an adjoining area's top layer, including shoulders. Do not operate spreading equipment on any area's top layer until completing final compaction.

If shoulders or median borders are shown, pave shoulders and median borders adjacent to the lane before opening a lane to traffic.

If shoulder conform tapers are shown, place conform tapers concurrently with the adjacent lane's paving.

If a driveway or a road connection is shown, place additional HMA along the pavement's edge to conform to road connections and driveways. Hand rake, if necessary, and compact the additional HMA to form a smooth conform taper.

### **39-2.01C(8) Leveling**

Section 39-2.01C(8) applies if a bid item for hot mix asphalt (leveling) is shown on the Bid Item List.

Fill and level irregularities and ruts with HMA before spreading HMA over the base, existing surfaces, or bridge decks. You may use mechanical equipment other than a paver for these areas. The equipment must produce uniform smoothness and texture. HMA used to change an existing surface's cross slope or profile is not paid for as hot mix asphalt (leveling).

### **39-2.01C(9) Miscellaneous Areas and Dikes**

Prepare the area to receive HMA for miscellaneous areas and dikes, including excavation and backfill as needed.

Spread the HMA in miscellaneous areas in 1 layer and compact to the specified lines and grades.

In median areas adjacent to slotted median drains, each layer of HMA must not exceed 0.20 foot maximum compacted thickness.

The finished surface must be:

1. Textured uniformly

2. Compacted firmly
3. Without depressions, humps, and irregularities

**39-2.01C(10)–39-2.01C(14) Reserved**

**39-2.01C(15) Compaction**

**39-2.01C(15)(a) General**

Rolling must leave the completed surface compacted and smooth without tearing, cracking, or shoving.

If a vibratory roller is used as a finish roller, turn the vibrator off.

Do not open new HMA pavement to traffic until its mid depth temperature is below 160 degrees F.

If the surface to be paved is both in sunlight and shade, pavement surface temperatures are taken in the shade.

**39-2.01C(15)(b) Method Compaction**

Use method compaction for all conditions.

HMA compaction coverage is the number of passes needed to cover the paving width. A pass is 1 roller's movement parallel to the paving in either direction. Overlapping passes are part of the coverage being made and are not a subsequent coverage. Do not start a coverage until completing the prior coverage.

Method compaction must consist of performing:

1. Breakdown compaction of each layer with 3 coverages using a vibratory roller. The speed of the vibratory roller in miles per hour must not exceed the vibrations per minute divided by 1,000. If the HMA layer thickness is less than 0.08 foot, turn the vibrator off.
2. Intermediate compaction of each layer of HMA with 3 coverages using a pneumatic-tired roller at a speed not to exceed 5 mph.
3. Finish compaction of HMA with 1 coverage using a steel-tired roller.

Start rolling at the lower edge and progress toward the highest part.

The Engineer may order fewer coverages if the layer thickness of HMA is less than 0.15 foot.

The compacted lift thickness must not exceed 0.25 foot.

**39-2.01C(15)(c)–39-2.01C(15)(e) Reserved**

**39-2.01C(16) Smoothness Corrections**

If the pavement surface does not comply with section 39-2.01A(4)(i)(iii), grind the pavement to within specified tolerances, remove and replace the pavement, or place an overlay of HMA. Do not start corrective work until your method is authorized.

Do not use equipment with carbide cutting teeth to grind the pavement unless authorized.

Smoothness corrections must leave at least 75 percent of the specified HMA thickness. If ordered, core the pavement at the locations selected by the Engineer. Coring, including traffic control, is change order work. Remove and replace deficient pavement areas where the overlay thickness is less than 75 percent of the thickness specified.

Corrected HMA pavement areas must be uniform rectangles, half the lane width, with edges:

1. Parallel to and along the nearest HMA pavement edge or lane line
2. Perpendicular to the pavement centerline

On ground areas not to be overlaid with OGFC, apply a fog seal under section 37-4.02.

Where corrections are made within areas requiring testing with inertial profiler, reprofile the entire lane length with the inertial profiler.

Where corrections are made within areas requiring testing with a 12-foot straightedge, retest the corrected area with the straightedge.

### **39-2.01C(17) Data Cores**

Section 39-2.01C(17) applies if a bid item for data core is shown on the Bid Item List.

Take data cores of the completed HMA pavement, underlying base, and subbase material. Notify the Engineer 3 business days before coring.

Protect data cores and surrounding pavement from damage.

Take 4-inch or 6-inch diameter data cores:

1. At the beginning, end, and every 1/2 mile within the paving limits of each route on the project
2. After all paving is complete
3. From the center of the specified lane

On a 2-lane roadway, take data cores from either lane. On a 4-lane roadway, take data cores from the outermost lane in each direction. On a roadway with more than 4 lanes, take data cores from the innermost lane and the outermost lane in each direction.

Each core must include the stabilized materials encountered. You may choose not to recover unstabilized material but you must identify the material. Unstabilized material includes any of the following:

1. Granular material
2. Crumbled or cracked stabilized material
3. Sandy or clayey soil

Where data core samples are taken, backfill and compact the holes with an authorized material.

After data core summary and photograph submittal, dispose of cores.

### **39-2.01D Payment**

The payment quantity for geosynthetic pavement interlayer is the area measured from the actual pavement covered.

Except for tack coat used in minor HMA, payment for tack coat is not included in the payment for hot mix asphalt.

The Department does not adjust the unit price for an increase or decrease in the tack coat quantity.

The payment quantity for HMA of the type shown on the Bid Item List is measured based on the combined mixture weight. If recorded batch weights are printed automatically, the bid item for HMA is measured by using the printed batch weights, provided:

1. Total aggregate and supplemental fine aggregate weight per batch is printed. If supplemental fine aggregate is weighed cumulatively with the aggregate, the total aggregate batch weight must include the supplemental fine aggregate weight.
2. Total virgin asphalt binder weight per batch is printed.
3. Each truckload's zero tolerance weight is printed before weighing the first batch and after weighing the last batch.
4. Time, date, mix number, load number and truck identification is correlated with a load slip.
5. Copy of the recorded batch weights is certified by a licensed weigh master and submitted.

The payment quantity for place hot mix asphalt dike of the type shown on the Bid Item List is the length measured from end to end. Payment for the HMA used to construct the dike is not included in the payment for place hot mix asphalt dike.

The payment quantity for place hot mix asphalt (miscellaneous areas) is the area measured for the in-place compacted area. Payment for the HMA used for miscellaneous areas is not included in the payment for place hot mix asphalt (miscellaneous areas).

The Engineer does not adjust the unit price for an increase or decrease in the prepaving grinding day quantity.

## **39-2.02 TYPE A HOT MIX ASPHALT**

### **39-2.02A General**

#### **39-2.02A(1) Summary**

Section 39-2.02 includes specifications for producing and placing Type A hot mix asphalt.

You may produce Type A HMA using an authorized WMA technology.

#### **39-2.02A(2) Definitions**

Reserved

#### **39-2.02A(3) Submittals**

##### **39-2.02A(3)(a) General**

Reserved

##### **39-2.02A(3)(b) Job Mix Formula**

The JMF must be based on the superpave HMA mix design as described in *MS-2 Asphalt Mix Design Methods* by the Asphalt Institute.

##### **39-2.02A(3)(c) Reclaimed Asphalt Pavement**

Submit QC test results for RAP gradation with the combined aggregate gradation within 2 business days of taking RAP samples during Type A HMA production.

##### **39-2.02A(3)(d)–39-2.02A(3)(f) Reserved**

#### **39-2.02A(4) Quality Assurance**

##### **39-2.02A(4)(a) General**

Reserved

##### **39-2.02A(4)(b) Quality Control**

###### **39-2.02A(4)(b)(i) General**

Reserved

###### **39-2.02A(4)(b)(ii) Aggregates**

Test the quality characteristics of aggregates under the test methods and frequencies shown in the following table:

### Aggregate Testing Frequencies

Quality characteristic	Test method	Minimum testing frequency
Gradation <sup>a</sup>	AASHTO T 27	1 per 750 tons and any remaining part
Sand equivalent <sup>b, c</sup>	AASHTO T 176	
Moisture content <sup>d</sup>	AASHTO T 255	
Crushed particles	AASHTO T 335	1 per 10,000 tons or 2 per project whichever is greater
Los Angeles Rattler	AASHTO T 96	
Flat and elongated particles	ASTM D4791	
Fine aggregate angularity	AASHTO T 304 Method A	
Coarse durability index	AASHTO T 210	1 per 3,000 or 1 per paving day, whichever is greater
Fine durability index	AASHTO T 210	

<sup>a</sup>If RAP is used, test the combined aggregate gradation under California Test 384.

<sup>b</sup>Reported value must be the average of 3 tests from a single sample.

<sup>c</sup>Use of a sand reading indicator is required as shown in AASHTO T 176, Figure 1. Sections 4.7, "Manual Shaker," 7.1.2, "Alternate Method No. 2," and 8.4.3, "Hand Method," do not apply. Prepare the stock solution as specified in section 4.8.1, "Stock solution with formaldehyde," except omit the addition of formaldehyde.

<sup>d</sup>Test at continuous mixing plants only. If RAP is used, test the RAP moisture content at continuous mixing plant and batch mixing plant.

For lime treated aggregate, test aggregate before treatment and test for gradation and moisture content during HMA production.

#### **39-2.02A(4)(b)(iii) Reclaimed Asphalt Pavement**

Sample and test processed RAP at a minimum frequency of 1 sample per 1,000 tons with a minimum of 6 samples per fractionated stockpile. If the fractionated stockpile has not been augmented, the 3 RAP samples taken and tested for mix design can be part of this minimum sample requirement. If a processed RAP stockpile is augmented, sample and test processed RAP quality characteristics at a minimum frequency of 1 sample per 500 tons of augmented RAP.

The combined RAP sample when tested under AASHTO T 164 must be within  $\pm 2.00$  percent of the average asphalt binder content reported on page 4 of your Contractor Hot Mix Asphalt Design Data form. If a new processed RAP stockpile is required, the average binder content of the new processed RAP stockpile must be within  $\pm 2.00$  percent of the average binder reported on page 4 of your Contractor Hot Mix Asphalt Design Data form.

The combined RAP sample when tested under AASHTO T 209 must be within  $\pm 0.06$  of the average maximum specific gravity reported on page 4 of your Contractor Hot Mix Asphalt Design Data form.

During Type A HMA production, sample RAP twice daily and perform QC testing for:

1. Aggregate gradation at least once a day under California Test 384
2. Moisture content at least twice a day

#### **39-2.02A(4)(b)(iv)–39-2.02A(4)(b)(viii) Reserved**

#### **39-2.02A(4)(b)(ix) Type A Hot Mix Asphalt Production**

Test the quality characteristics of Type A HMA under the test methods and frequencies shown in the following table:

**Type A HMA Production Testing Frequencies**

Quality characteristic	Test method	Minimum testing frequency
Asphalt binder content	AASHTO T 308, Method A	1 per 750 tons and any remaining part
HMA moisture content	AASHTO T 329	1 per 2,500 tons but not less than 1 per paving day
Air voids content	AASHTO T 269	1 per 4,000 tons or 2 every 5 paving days, whichever is greater
Voids in mineral aggregate	MS-2MS-2 Asphalt Mixture Volumetrics	1 per 10,000 tons or 2 per project whichever is greater
Dust proportion	MS-2MS-2 Asphalt Mixture Volumetrics	
Density of core	California Test 375	2 per paving day
Nuclear gauge density	California Test 375	3 per 250 tons or 3 per paving day, whichever is greater
Hamburg wheel track	AASHTO T 324 (Modified)	1 per 10,000 tons or 1 per project, whichever is greater
Moisture susceptibility	AASHTO T 283	

**39-2.02A(4)(c)–39-2.02A(4)(d) Reserved**

**39-2.02A(4)(e) Department Acceptance**

The Department accepts Type A HMA based on compliance with:

1. Aggregate quality requirements shown in the following table:

**Aggregate Quality**

Quality characteristic	Test method	Requirement
Aggregate gradation <sup>a</sup>	AASHTO T 27	JMF ± Tolerance
Percent of crushed particles	AASHTO T 335	95
Coarse aggregate (min, %)		
One-fractured face		
Two-fractured faces		
Fine aggregate (min, %)	AASHTO T 335	90
(Passing No. 4 sieve and retained on No. 8 sieve.)		
One-fractured face		70
Los Angeles Rattler (max, %)	AASHTO T 96	12
Loss at 100 Rev.		
Loss at 500 Rev.		
Sand equivalent (min.) <sup>b, c</sup>	AASHTO T 176	47
Flat and elongated particles (max, % by weight at 5:1)	ASTM D4791	10
Fine aggregate angularity (min, %) <sup>d</sup>	AASHTO T 304, Method A	45
Coarse durability index (D <sub>c</sub> , min)	AASHTO T 210	65
Fine durability index (D <sub>f</sub> , min)	AASHTO T 210	50

<sup>a</sup>The Engineer determines combined aggregate gradations containing RAP under California Test 384.

<sup>b</sup>Reported value must be the average of 3 tests from a single sample.

<sup>c</sup>Use of a sand reading indicator is required as shown in AASHTO T 176, Figure 1. Sections 4.7, "Manual Shaker," 7.1.2, "Alternate Method No. 2," and 8.4.3, "Hand Method," do not apply. Prepare the stock solution as specified in section 4.8.1, "Stock solution with formaldehyde," except omit the addition of formaldehyde.

<sup>d</sup>The Engineer waives this specification if HMA contains 10 percent or less of nonmanufactured sand by weight of total aggregate. Manufactured sand is fine aggregate produced by crushing rock or gravel.

2. If RAP is used, RAP quality requirements shown in the following table:

**Reclaimed Asphalt Pavement Quality**

Quality characteristic	Test method	Requirement
Binder content (% within the average value reported)	AASHTO T 164	±2.00
Specific gravity (within the average value reported)	AASHTO T 209	±0.06

3. In place Type A HMA quality requirements shown in the following table:



**Type A HMA Acceptance In Place**

Quality characteristic	Test method	Requirement
Asphalt binder content (%)	AASHTO T 308 Method A	JMF -0.30, +0.50
HMA moisture content (max, %)	AASHTO T 329	1.00
Air voids content at N <sub>design</sub> (%) <sup>a, b</sup>	AASHTO T 269	4.0 ± 1.5 (5.0 ± 1.5 for 1-inch aggregate)
Voids in mineral aggregate on laboratory-produced HMA (min, %) <sup>d</sup> Gradation: No. 4 3/8-inch 1/2-inch 3/4-inch 1-inch with NMAS = 1-inch with NMAS = 3/4-inch	MS-2MS-2 Asphalt Mixture Volumetrics	16.5–19.5 15.5–18.5 14.5–17.5 13.5–16.5  13.5–16.5 14.5–17.5
Voids in mineral aggregate on plant-produced HMA (min, %) <sup>a</sup> Gradation: No. 4 3/8-inch 1/2-inch 3/4-inch 1-inch with NMAS = 1-inch with NMAS = 3/4-inch	MS-2MS-2 Asphalt Mixture Volumetrics <sup>c</sup>	15.5–18.5 14.5–17.5 13.5–16.5 12.5–15.5  12.5–15.5 13.5–16.5
Dust proportion	MS-2MS-2 Asphalt Mixture Volumetrics	0.6–1.3 <sup>g</sup>
Density of core (% of max theoretical density) <sup>e, f</sup>	California Test 375	91.0–97.0
Hamburg wheel track (min number of passes at 0.5-inch rut depth) Binder grade: PG 58 PG 64 PG 70 PG 76 or higher	AASHTO T 324 (Modified)	10,000 15,000 20,000 25,000
Hamburg wheel track (min number of passes at inflection point) Binder grade: PG 58 PG 64 PG 70 PG 76 or higher	AASHTO T 324 (Modified)	10,000 10,000 12,500 15,000
Moisture susceptibility (min, psi, dry strength)	AASHTO T 283	100
Moisture susceptibility (min, psi, wet strength)	AASHTO T 283	70

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<sup>a</sup>Prepare 3 briquettes. Report the average of 3 tests.

<sup>b</sup>The Engineer determines the bulk specific gravity of each lab-compacted briquette under AASHTO T 275, Method A, and theoretical maximum specific gravity under AASHTO T 209, Method A.

<sup>c</sup>Determine bulk specific gravity under AASHTO T 275, Method A.

<sup>d</sup>The Engineer determines the laboratory-prepared Type A HMA value for only mix design verification.

<sup>e</sup>The Engineer determines percent of theoretical maximum density under California Test 375 except the Engineer uses:

1. AASHTO T 275 to determine in-place density of each density core
2. AASHTO T 209, Method A to determine theoretical maximum density instead of calculating test maximum density

<sup>f</sup>The Engineer determines theoretical maximum density under AASHTO T 209, Method A, at the frequency specified in California Test 375, part 5, section D.

<sup>g</sup>For lime-treated aggregates, the dust proportion requirement is 0.6–1.5.

### **39-2.02B Materials**

#### **39-2.02B(1) General**

Reserved

### 39-2.02B(2) Type A Hot Mix Asphalt Mix Design

The mix design for Type A HMA must comply with the requirements shown in the following table:

**Type A HMA Mix Design Requirements**

Quality characteristic	Test method	Requirement
Air voids content (%)	AASHTO T 269 <sup>a</sup>	N <sub>initial</sub> > 8.0 N <sub>design</sub> = 4.0 (N <sub>design</sub> = 5.0 for 1-inch aggregate) N <sub>max</sub> > 2.0
Gyrations compaction (no. of gyrations)	AASHTO T 312	N <sub>initial</sub> = 8 N <sub>design</sub> = 85.0 N <sub>max</sub> = 130
Voids in mineral aggregate (min, %) <sup>b</sup> Gradation: No. 4 3/8-inch 1/2-inch 3/4-inch 1-inch with NMAS = 1-inch with NMAS = 3/4-inch	MS-2 Asphalt Mixture Volumetrics	16.5–19.5 15.5–18.5 14.5–17.5 13.5–16.5  13.5–16.5 14.5–17.5
Dust proportion	MS-2 Asphalt Mixture Volumetrics	0.6–1.3
Hamburg wheel track (min number of passes at 0.5-inch rut depth) Binder grade: PG 58 PG 64 PG 70 PG 76 or higher	AASHTO T 324 (Modified) <sup>c</sup>	10,000 15,000 20,000 25,000
Hamburg wheel track (min number of passes at the inflection point) Binder grade: PG 58 PG 64 PG 70 PG 76 or higher	AASHTO T 324 (Modified) <sup>c</sup>	10,000 10,000 12,500 15,000
Moisture susceptibility, dry strength (min, psi)	AASHTO T 283 <sup>c</sup>	100
Moisture susceptibility, wet strength (min, psi)	AASHTO T 283 <sup>c, d</sup>	70

<sup>a</sup>Calculate the air voids content of each specimen using AASHTO T 275, Method A, to determine bulk specific gravity. Use AASHTO T 209, Method A, to determine theoretical maximum specific gravity. Use a digital manometer and pycnometer when performing AASHTO T 209.

<sup>b</sup>Measure bulk specific gravity using AASHTO T 275, Method A.

<sup>c</sup>Test plant-produced Type A HMA.

<sup>d</sup>Freeze thaw required.

For Type A HMA mixtures using RAP, the maximum allowed binder replacement is 15.0 percent.

### 39-2.02B(3) Asphalt Binder

The grade of asphalt binder for Type A HMA must be PG 64-10.

**39-2.02B(4) Aggregates**

**39-2.02B(4)(a) General**

Before the addition of asphalt binder and lime treatment, the aggregates must comply with the requirements shown in the following table:

<b>Aggregate Quality</b>		
Quality characteristic	Test method	Requirement
Percent of crushed particles:		
Coarse aggregate (min, %)		
One-fractured face		95
Two-fractured faces		90
Fine aggregate (min, %)	AASHTO T 335	
(Passing No. 4 sieve and retained on No. 8 sieve.)		
One-fractured face		70
Los Angeles Rattler (max, %)		
Loss at 100 Rev.	AASHTO T 96	12
Loss at 500 Rev.		40
Sand equivalent (min) <sup>a</sup>	AASHTO T 176	47
Flat and elongated particles (max, % by weight at 5:1)	ASTM D4791	10
Fine aggregate angularity (min, %) <sup>b</sup>	AASHTO T 304, Method A	45

<sup>a</sup>The reported value must be the average of 3 tests from a single sample. Use of a sand reading indicator is required as shown in AASHTO T 176, Figure 1. Sections 4.7, "Manual Shaker," 7.1.2, "Alternate Method No. 2," and 8.4.3, "Hand Method," do not apply. Prepare the stock solution as specified in section 4.8.1, "Stock solution with formaldehyde," except omit the addition of formaldehyde.

<sup>b</sup>The Engineer waives this specification if the Type A HMA contains 10 percent or less of nonmanufactured sand by weight of total aggregate, except if your JMF fails verification. Manufactured sand is fine aggregate produced by crushing rock or gravel.

**39-2.02B(4)(b) Aggregate Gradations**

The aggregate gradations for Type A HMA must comply with the requirements shown in the following table:

<b>Aggregate Gradation Requirements</b>	
Type A HMA pavement thickness shown	Gradation
0.10 foot	3/8 inch
Greater than 0.10 to less than 0.20 foot	1/2 inch
0.20 to less than 0.25 foot	3/4 inch
0.25 foot or greater	3/4 inch or 1 inch

Aggregate gradation must be within the TV limits for the specified sieve size shown in the following tables:

**Aggregate Gradations for Type A HMA  
(Percentage Passing)**

**1 inch**

Sieve size	Target value limit	Allowable tolerance
1"	100	--
3/4"	88–93	TV ± 5
1/2"	72–85	TV ± 6
3/8"	55–70	TV ± 6
No. 4	35–52	TV ± 7
No. 8	22–40	TV ± 5
No. 30	8–24	TV ± 4
No. 50	5–18	TV ± 4
No. 200	3.0–7.0	TV ± 2.0

**3/4 inch**

Sieve size	Target value limit	Allowable tolerance
1"	100	--
3/4"	90–98	TV ± 5
1/2"	70–90	TV ± 6
No. 4	42–58	TV ± 5
No. 8	29–43	TV ± 5
No. 30	10–23	TV ± 4
No. 200	2.0–7.0	TV ± 2.0

**1/2 inch**

Sieve size	Target value limit	Allowable tolerance
3/4"	100	--
1/2"	95–98	TV ± 5
3/8"	72–95	TV ± 5
No. 4	52–69	TV ± 5
No. 8	35–55	TV ± 5
No. 30	15–30	TV ± 4
No. 200	2.0–8.0	TV ± 2.0

**3/8 inch**

Sieve size	Target value limit	Allowable tolerance
1/2"	100	--
3/8"	95–98	TV ± 5
No. 4	55–75	TV ± 5
No. 8	30–50	TV ± 5
No. 30	15–35	TV ± 5
No. 200	2.0–9.0	TV ± 2.0

**No. 4**

Sieve size	Target value limit	Allowable tolerance
3/8"	100	--
No. 4	95–98	TV ± 5
No. 8	70–80	TV ± 6
No. 30	34–45	TV ± 5
No. 200	2.0–12.0	TV ± 4.0

**39-2.02B(5) Reclaimed Asphalt Pavement**

You may substitute RAP for part of the virgin aggregate in a quantity up to 15 percent of the aggregate blend.

Provide enough space at your plant for complying with all RAP handling requirements. Provide a clean, graded base, well drained area for stockpiles.

Isolate the processed RAP stockpiles from other materials. Store processed RAP in conical or longitudinal stockpiles. Processed RAP must not be agglomerated or be allowed to congeal in large stockpiles.

**39-2.02B(6)–39-2.02B(10) Reserved**

**39-2.02B(11) Type A Hot Mix Asphalt Production**

If RAP is used, the asphalt plant must automatically adjust the virgin asphalt binder to account for RAP percentage and RAP binder.

During production, you may adjust hot- or cold-feed proportion controls for virgin aggregate and RAP. RAP must be within ±3 of RAP percentage described in your Contractor Job Mix Formula Proposal form without exceeding 15 percent.

**39-2.02C Construction**

Where the pavement thickness shown is greater than 0.30 foot, you may place Type A HMA in multiple lifts not less than 0.15 foot each. If placing Type A HMA in multiple lifts:

- 1. Aggregate gradation must comply with the requirements shown in the following table:

**Aggregate Gradation Requirements**

Type A HMA lift thickness	Gradation
0.15 to less than 0.20 foot	1/2 inch
0.20 foot to less than 0.25 foot	3/4 inch
0.25 foot or greater	3/4 inch or 1 inch

- 2. Apply a tack coat before placing a subsequent lift
- 3. The Engineer evaluates each HMA lift individually for compliance

If the ambient air temperature is below 60 degrees F, cover the loads in trucks with tarpaulins. If the time for HMA discharge to truck at the HMA plant until transfer to paver's hopper is 90 minutes or greater and if the ambient air temperature is below 70 degrees F, cover the loads in trucks with tarpaulins, unless the time from discharging to the truck until transfer to the paver's hopper or the pavement surface is less than 30 minutes. The tarpaulins must completely cover the exposed load until you transfer the mixture to the paver's hopper or the pavement surface.

Spread Type A HMA at the ambient air and surface temperatures shown in the following table:

**Minimum Ambient Air and Surface Temperatures**

Lift thickness (feet)	Ambient air (°F)		Surface (°F)	
	Unmodified asphalt binder	Modified asphalt binder	Unmodified asphalt binder	Modified asphalt binder
Type A HMA and Type A HMA produced with WMA water injection technology				
<0.15	55	50	60	55
≥0.15	45	45	50	50
Type A HMA produced with WMA additive technology				
<0.15	45	45	50	45
≥0.15	40	40	40	40

For Type A HMA and Type A HMA produced with WMA water injection technology placed under method compaction, if the asphalt binder is:

1. Unmodified, complete:
  - 1.1. 1st coverage of breakdown compaction before the surface temperature drops below 250 degrees F
  - 1.2. Breakdown and intermediate compaction before the surface temperature drops below 190 degrees F
  - 1.3. Finish compaction before the surface temperature drops below 150 degrees F
2. Modified, complete:
  - 2.1. 1st coverage of breakdown compaction before the surface temperature drops below 240 degrees F
  - 2.2. Breakdown and intermediate compaction before the surface temperature drops below 180 degrees F
  - 2.3. Finish compaction before the surface temperature drops below 140 degrees F

For Type A HMA produced with WMA additive technology placed under method compaction, if the asphalt binder is:

1. Unmodified, complete:
  - 1.1. 1st coverage of breakdown compaction before the surface temperature drops below 240 degrees F
  - 1.2. Breakdown and intermediate compaction before the surface temperature drops below 190 degrees F
  - 1.3. Finish compaction before the surface temperature drops below 140 degrees F
  - 1.4. You may continue static rolling below 140 degrees F to remove roller marks.
2. Modified, complete:
  - 2.1. 1st coverage of breakdown compaction before the surface temperature drops below 230 degrees F
  - 2.2. Breakdown and intermediate compaction before the surface temperature drops below 170 degrees F
  - 2.3. Finish compaction before the surface temperature drops below 130 degrees F
  - 2.4. You may continue static rolling below 130 degrees F to remove roller marks.

You may cool Type A HMA with water when rolling activities are complete if authorized.

### **39-2.02D Payment**

Not Used

## **39-2.07 MINOR HOT MIX ASPHALT**

### **39-2.07A General**

#### **39-2.07A(1) Summary**

Section 39-2.07 includes specifications for producing and placing minor hot mix asphalt.

Minor HMA must comply with section 39-2.02 except as specified in this section 39-2.07.

The inertial profiler requirements in section 36-3 do not apply.

#### **39-2.07A(2) Definitions**

Reserved

#### **39-2.07A(3) Submittals**

The QC plan and test results in sections 39-2.01A(3)(c) and 39-2.01A(3)(d) do not apply.

**39-2.07A(4) Quality Assurance**

**39-2.07A(4)(a) General**

The JMF renewal requirements in section 39-2.01A(4)(d) do not apply.

Test pavement smoothness with a 12 foot straightedge.

**39-2.07A(4)(b) Quality Control**

Testing for compliance with the following quality characteristics is not required:

1. Flat and elongated particles
2. Fine aggregate angularity
3. Hamburg wheel track
4. Moisture susceptibility

**39-2.07A(4)(c) Department Acceptance**

The Department accepts minor HMA under section 39-2.02A(4)(e) except for compliance with requirements for the following quality characteristics:

1. Flat and elongated particles
2. Fine aggregate angularity
3. Hamburg wheel track
4. Moisture susceptibility

**39-2.07B Materials**

**39-2.07B(1) General**

Reserved

**39-2.07B(2) Minor Hot Mix Asphalt Mix Design**

The Hamburg wheel track and moisture susceptibility requirements do not apply to the mix design for minor HMA.

**39-2.07B(3) Asphalt Binder**

The grade of asphalt binder for minor HMA must be PG-64-10 or PG-64-16.

**39-2.07B(4) Liquid Antistrip Treatment**

Treat minor HMA with liquid antistrip unless you submit AASHTO T 283 and AASHTO T 324 (Modified) test results showing compliance with section 39-2.02B and dated within 12 months of the submittal.

**39-2.07C Construction**

Not Used

**39-2.07D Payment**

Not Used

**39-2.08–39-2.10 RESERVED**

**39-3 EXISTING ASPHALT CONCRETE**

**39-3.01 GENERAL**

**39-3.01A General**

Section 39-3.01 includes general specifications for performing work on existing asphalt concrete facilities.

Work performed on existing asphalt concrete facilities must comply with section 15.

**39-3.01B Materials**

Not Used



### **39-3.01C Construction**

Before removing a portion of an asphalt concrete facility, make a 2-inch deep saw cut to a true line along the limits of the removal area.

### **39-3.01D Payment**

Not Used

## **39-3.02 REPLACE ASPHALT CONCRETE SURFACING**

### **39-3.02A General**

Section 39-3.02 includes specifications for replacing asphalt concrete surfacing.

### **39-3.02B Materials**

HMA to be used for replacing asphalt concrete surfacing must comply with Type A HMA as specified in section 39-2.02.

The grade of asphalt binder must be PG 64-10 or PG 64-16.

Tack coat must comply with section 39-2.01B(10).

### **39-3.02C Construction**

Where replace asphalt concrete surfacing is shown, remove the full depth of the existing asphalt concrete surfacing and replace with HMA. The Engineer determines the exact limits of asphalt concrete surfacing to be replaced.

Replace asphalt concrete in a lane before the lane is specified to be opened to traffic.

Before removing asphalt concrete, outline the replacement area and cut neat lines with a saw or grind to full depth of the existing asphalt concrete. Do not damage asphalt concrete and base remaining in place.

If you excavate the base beyond the specified plane, replace it with HMA.

Do not use a material transfer vehicle for replacing asphalt concrete surfacing.

Before placing HMA, apply a tack coat as specified in section 39-2.01C(3)(f).

Place HMA using method compaction as specified in section 39-2.01C(2)(c).

### **39-3.02D Payment**

The payment quantity for replace asphalt concrete surfacing is the volume determined from the dimensions shown.

## **39-3.03 REMOVE ASPHALT CONCRETE DIKES**

### **39-3.03A General**

Section 39-3.03 applies to removing asphalt concrete dikes outside the limits of excavation.

### **39-3.03B Materials**

Not Used

### **39-3.03C Construction**

Reserved

### **39-3.03D Payment**

Not Used

## **39-3.04 COLD PLANING ASPHALT CONCRETE PAVEMENT**

### **39-3.04A General**

Section 39-3.04 includes specifications for cold planing asphalt concrete pavement.

Cold planing asphalt concrete pavement includes the removal of pavement markers, traffic stripes, and pavement markings within the area of cold planing.

Schedule cold planing activities such that the pavement is cold planed, the HMA is placed, and the area is opened to traffic during the same work shift.

#### **39-3.04B Materials**

HMA for temporary tapers must be of the same quality that is used for the HMA overlay or comply with the specifications for minor HMA in section 39-2.07.

#### **39-3.04C Construction**

##### **39-3.04C(1) General**

Do not use a heating device to soften the pavement.

The cold planing machine must be:

1. Equipped with a cutter head width that matches the planing width unless a wider cutter head is authorized.
2. Equipped with automatic controls for the longitudinal grade and transverse slope of the cutter head and:
  - 2.1. If a ski device is used, it must be at least 30 feet long, rigid, and a 1-piece unit. The entire length must be used in activating the sensor.
  - 2.2. If referencing from existing pavement, the cold planing machine must be controlled by a self-contained grade reference system. The system must be used at or near the centerline of the roadway. On the adjacent pass with the cold planing machine, a joint-matching shoe may be used.
3. Equipped to effectively control dust generated by the planing operation
4. Operated such that no fumes or smoke is produced.

Replace broken, missing, or worn machine teeth.

If you do not complete placing the HMA surfacing before opening the area to traffic, you must:

1. Construct a temporary HMA taper to the level of the existing pavement.
2. Place HMA during the next work shift.
3. Submit a corrective action plan that shows you will complete cold planing and placement of HMA in the same work shift. Do not restart cold planing activities until the corrective action plan is authorized.

##### **39-3.04C(2) Grade Control and Surface Smoothness**

Install and maintain grade and transverse slope references.

The final cut must result in a neat and uniform surface.

The completed surface of the planed pavement must not vary more than 0.02 foot when measured with a 12-foot straightedge parallel with the centerline. With the straightedge at right angles to the centerline, the transverse slope of the planed surface must not vary more than 0.03 foot.

Where lanes are open to traffic, the drop-off of between adjacent lanes must not be more than 0.15 foot.

##### **39-3.04C(3) Planed Material**

Remove cold planed material concurrently with planing activities such that the removal does not lag more than 50 feet behind the planer.

##### **39-3.04C(4) Temporary HMA Tapers**

If a drop-off between the existing pavement and the planed area at transverse joints cannot be avoided before opening to traffic, construct a temporary HMA taper.

Compact by any method that will produce a smooth riding surface

Completely remove temporary tapers before placing permanent surfacing.

**39-3.04D Payment**

Not Used

**39-3.05–39-3.08 RESERVED**

## **DIVISION IX TRAFFIC CONTROL DEVICES**

### **82 SIGNS AND MARKERS**

**Replace Section 82-1.01A with:**

**82-1.01A Summary**

Section 82-1 includes general specifications for fabricating and installing sign panels and markers and constructing roadside signs.

Signs and markers must comply with the *California MUTCD*, *California Sign Specifications*, and the FHWA publication *Standard Highway Signs and Markings*. For the *California Sign Specifications*, go to the Caltrans Traffic Operations website.

**Replace Item 1 of the 2nd paragraph of section 82-2.02A with:**

1. Phrase *Property of The County of Fresno*

**Add to section 82-2.02B:**

Signs must be 0.080 inch thick aluminum alloy and street name signs must be 0.125 inch thick alloy faced on both sides.

**Add to section 82-2.02C:**

Reflective sheeting on all signs shall be 3M Diamond Grade DG3 Series 4000 or equal, and must meet ASTM Type XI specifications.

**Add to section 82-2.02D:**

All signs must have the 3M 1160 graffiti resistant clear overlay film or equal.

**Replace Section 82-2.04 with:**

**82-2.04 PAYMENT**

Not Used

**Add to section 82-3.02A:**

All new roadside signs must be square post 14 gauge steel.

**Add to section 82-3.02B:**

All post for traffic signs must be 2"X2"X10' square by 14 gauge steel, with 7/16 inch holes punched one inch on center on all four sides for the entire length of the post.

Welded Anchor (2 ¼"X2 ¼"X30") and sleeve (2 ½"X2 ½"X18") shall be used as a base to anchor post in the ground. Hole size and placement must be the same as the metal post.

All mounting hardware shall be either galvanized or stainless steel. Banding shall be 3/4 inch wide stainless steel with flare leg sign brackets. Hose clamps are not permitted. All signs shall be mounted using 3/8" aluminum drive rivets. Nuts and bolts are not permitted.

**Replace Section 82-3.02D with:**

**82-3.02D Laminated Wood Box Posts**

Furnish a laminated wood box post with an attached metal cap at the top of each post.

**Replace the last line of section 82-3.04 with:**

Full compensation for furnishing sign panels is included in the bid item price per each Roadside Sign - One Post and Roadside Sign - Two Post. One or more sign panels furnished and installed on a single post will be counted as (1) one Roadside Sign - One Post. One or more sign panels furnished and installed on two posts will be counted as (1) one Roadside Sign - Two Post.

## **DIVISION XI MATERIALS**

### **90 CONCRETE**

**Replace Section 90-1.01D(3) with:**

**90-1.01D(3) Shrinkage**

If shrinkage limitations are specified, test the concrete under AASHTO T 160, modified as follows:

1. Prepare specimens that have a 4 by 4-inch cross section.
2. Remove each specimen from the mold  $23 \pm 1$  hours after mixing the concrete and place the specimen in lime water at  $73 \pm 3$  degrees F until 7 days age.
3. Take a comparator reading at 7 days age and record it as the initial reading.
4. Store the specimens in a humidity-controlled room maintained at  $73 \pm 3$  degrees F and  $50 \pm 4$  percent relative humidity for the remainder of the test.
5. Take subsequent readings at 7, 14, 21, and 28 days drying.

Perform AASHTO T 160 testing at a laboratory that is accredited to perform AASHTO T 160 or that maintains a current rating of 3 or better for the Cement and Concrete Reference Laboratory concrete proficiency sample program.

Shrinkage test data authorized by Caltrans no more than 3 years before the 1st day of the Contract is authorized for the entire Contract. The test data must be for concrete with similar proportions and using the same materials and material sources to be used on the Contract. Concrete is considered to have similar proportions if no more than 2 mix design elements are varied and the variation is within the tolerances shown in the following table:

Mix design element	Tolerance (±)
Water to cementitious material ratio	0.03
Total water content (%)	5
Coarse aggregate content (%)	10
Fine aggregate content (%)	10
SCM content (%)	5
Admixture as originally dosed <sup>a</sup> (%)	25

<sup>a</sup>Admixtures must be the same brand.

**Replace Section 90-2.02E With:**

**90-2.02E Production**

Sections 90-1.02F, 90-1.02G(1), 90-1.02G(2), 90-1.02G(3), and 90-1.02G(4) do not apply to minor concrete.

Store, proportion, mix, transport, and discharge the cementitious material, water, aggregate, and admixtures in compliance with recognized standards of good practice that result in thoroughly and uniformly mixed concrete suitable for the intended use. Recognized standards of good practice are outlined in various industry publications, such as those issued by ACI, AASHTO, or by Caltrans.

Use a quantity of water that produces concrete with a consistency that complies with section 90-1.02G(6). Do not add water during hauling or after arrival at the delivery point unless allowed by the Engineer.

Discharge ready-mixed concrete from the transport vehicle while the concrete is still plastic and before stiffening occurs. Take whatever action is necessary to eliminate quick stiffening, except do not add water.

Conditions contributing to quick stiffening are:

1. Elapsed time of 1.5 hours in agitating hauling equipment or 1 hour in nonagitating hauling equipment
2. More than 250 revolutions of the drum or blades after introduction of the cementitious material to the aggregates
3. Concrete temperature over 90 degrees F

The mixing time in a stationary mixer must be at least 50 seconds and no more than 5 minutes.

The minimum required revolutions at mixing speed for transit-mixed concrete must be at least that recommended by the mixer manufacturer and must be increased as needed to produce thoroughly and uniformly mixed concrete.

If you add a high-range water-reducing admixture to the concrete at the job site, the total revolutions must not exceed 300.

**Replace Section 90-4.02 With:**

**90-4.02 MATERIALS**

You may use Type III portland cement in PC concrete.

The specifications for SCM content in section 90-1.02B(3) do not apply to PC concrete.

For PC concrete, the SCM content must comply with one of the following:

1. Any combination of portland cement and SCM satisfying the following equation:

Equation 1:

$$[(25 \times UF) + (12 \times FA) + (10 \times FB) + (6 \times SL)]/TC \geq X$$

where:

UF = silica fume, metakaolin, or UFFA, including the quantity in blended cement, lb/cu yd

*FA* = natural pozzolan or fly ash complying with AASHTO M 295, Class F or N, with a CaO content of up to 10 percent, including the quantity in blended cement, lb/cu yd

*FB* = natural pozzolan or fly ash complying with AASHTO M 295, Class F or N, with a CaO content of greater than 10 percent and up to 15 percent, including the quantity in blended cement, lb/cu yd

*SL* = GGBFS, including the quantity in blended cement, lb/cu yd

*TC* = total quantity of cementitious material, lb/cu yd

*X* = 0.0 for innocuous aggregate, 3.0 for all other aggregate

2. 15 percent Class F fly ash with at least 48 oz of LiNO<sub>3</sub> solution added per 100 lb of portland cement. The CaO content of the fly ash must not exceed 15 percent.
3. Any combination of SCM and portland cement for which the expansion of cementitious material and aggregate does not exceed 0.10 percent when tested under ASTM C1567. Submit test data with each mix design. Test data authorized by Caltrans no more than 3 years before the 1st day of the Contract is authorized for the entire Contract. The test data must be for the same concrete mix and must use the same materials and material sources to be used on the Contract.

If municipally supplied potable water is used for PC concrete, the testing specified in section 90-1.02D is waived unless requested.

Portland cement based repair material must be on the Authorized Material List for precast Portland cement based repair material.

## **92 ASPHALT BINDERS**

**Replace 92-1.01D(2) With:**

### **92-1.01D(2) Certification**

Asphalt binder suppliers must comply with the Caltrans Certification Program for Suppliers of Asphalt. For a copy of the certification program, go to the METS website.

**Replace Section 92-1.02B With**

### **92-1.02B Performance Grade Asphalt Binders**

PG asphalt binder must comply with the requirements shown in the following table:

**PG Asphalt Binders**

Quality characteristic	Test method	Requirement				
		PG 58-22 <sup>a</sup>	PG 64-10	PG 64-16	PG 64-28	PG 70-10
<b>Original Binder</b>						
Flash point (min, °C)	AASHTO T 48	230	230	230	230	230
Solubility <sup>b</sup> (min, %)	AASHTO T 44	99	99	99	99	99
Viscosity at 135 °C <sup>c</sup> (max, Pa•s)	AASHTO T 316	3.0	3.0	3.0	3.0	3.0
Dynamic shear Test temperature at 10 rad/s (°C) G*/sin(delta) (min, kPa) G*/sin(delta) (max, kPa)	AASHTO T 315	58 1.00 2.00	64 1.00 2.00	64 1.00 2.00	64 1.00 2.00	70 1.00 2.00
RTFO <sup>f</sup> test <sup>e</sup> mass loss (max, %)	AASHTO T 240	1.00	1.00	1.00	1.00	1.00
<b>RTFO<sup>f</sup> Test Aged Binder</b>						
Dynamic shear Test temperature at 10 rad/s (°C) G*/sin(delta) (min, kPa)	AASHTO T 315	58 2.20	64 2.20	64 2.20	64 2.20	70 2.20
Ductility at 25 °C (min, cm)	AASHTO T 51	75	75	75	75	75
PAV <sup>g</sup> Test temperature (°C)	AASHTO R 28	100	100	100	100	110
<b>RTFO<sup>f</sup> Test and PAV<sup>g</sup> Aged Binder</b>						
Dynamic shear, Test temperature at 10 rad/s (°C) G*/sin(delta) (max, kPa)	AASHTO T 315	22 <sup>d</sup> 5000	31 <sup>d</sup> 5000	28 <sup>d</sup> 5000	22 <sup>d</sup> 5000	34 <sup>d</sup> 5000
Creep stiffness, Test temperature, °C S-value (max, MPa) M-value (min)	AASHTO T 313	-12 300 0.300	0 300 0.300	-6 300 0.300	-18 300 0.300	0 300 0.300

<sup>a</sup>Use as asphalt rubber base stock for high mountain and high desert area.

<sup>b</sup>The Engineer waives solubility requirements if the supplier is an authorized material source as defined by the Caltrans *Certification Program for Suppliers of Asphalt*.

<sup>c</sup>The Engineer waives this specification if the supplier provides written certification the asphalt binder can be adequately pumped and mixed at temperatures meeting applicable safety standards.

<sup>d</sup>Test the sample at 3 °C higher if it fails at the specified test temperature. G\*/sin(delta) remains 5000 kPa maximum.

<sup>e</sup>The residue from mass change determination may be used for other tests.

<sup>f</sup>RTFO means rolling thin film oven.

<sup>g</sup>PAV means Pressure Aging Vessel.

PG modified asphalt binder must comply with the requirements shown in the following table:

**PG Modified Asphalt Binders**

Quality characteristic	Test method	Requirement		
		PG 58-34 M	PG 64-28 M	PG 76-22 M
Original Binder				
Flash point (min, °C)	AASHTO T 48	230	230	230
Solubility (min, %)	AASHTO T 44 <sup>a</sup>	97.5	97.5	97.5 <sup>b</sup>
Viscosity at 135 °C <sup>c</sup> (max, Pa·s)	AASHTO T 316	3.0	3.0	3.0
Dynamic shear, Test temperature at 10 rad/s (°C) G*/sin(delta) (min, kPa)	AASHTO T 315	58 1.00	64 1.00	76 1.00
RTFO <sup>g</sup> test <sup>d</sup> , Mass loss (max, %)	AASHTO T 240	1.00	1.00	1.00
RTFO <sup>g</sup> Test Aged Binder				
Dynamic shear, Test temperature at 10 rad/s (°C) G*/sin(delta) (min, kPa)	AASHTO T 315	58 2.20	64 2.20	76 2.20
Dynamic shear, Test temperature at 10 rad/s, °C Delta (max, degree)	AASHTO T 315	80 <sup>e</sup>	80 <sup>e</sup>	80 <sup>e</sup>
Elastic recovery <sup>f</sup> , Test temperature (°C) Recovery (min, %)	AASHTO T 301	25 75	25 75	25 65
PAV <sup>h</sup> , Temperature (°C)	AASHTO R 28	100	100	110
RTFO <sup>g</sup> Test and PAV <sup>h</sup> Aged Binder				
Dynamic shear, Test temperature at 10 rad/s (°C) G*/sin(delta) (max, kPa)	AASHTO T 315	16 5000	22 5000	31 5000
Creep stiffness, Test temperature (°C) S-value (max, Mpa) M-value (min)	AASHTO T 313	-24 300 0.300	-18 300 0.300	-12 300 0.300

<sup>a</sup>The Department allows ASTM D5546 or ASTM D7553 instead of AASHTO T 44. Particles recovered from ASTM D5546 or ASTM D7553 or AASHTO T 44 must be less than 250 µm.

<sup>b</sup>Report only for spray application.

<sup>c</sup>The Engineer waives the viscosity requirements if the supplier provides written certification the asphalt binder can be adequately pumped and mixed at temperatures meeting applicable safety standards.

<sup>d</sup>The residue from mass change determination may be used for other tests.

<sup>e</sup>Test temperature is the temperature at which G\*/sin(delta) is 2.2 kPa. A graph of log G\*/sin(delta) plotted against temperature may be used to determine the test temperature when G\*/sin(delta) is 2.2 kPa. A graph of (delta) versus temperature may be used to determine delta at the temperature when G\*/sin(delta) is 2.2 kPa. The graph must have at least 2 points that envelope G\*/sin(delta) of 2.2 kPa, and the test temperature must not be more than 6 degree C apart. The Engineer also accepts direct measurement of delta at the temperature when G\*/sin(delta) is 2.2 kPa.

<sup>f</sup>Tests without a force ductility clamp may be performed.

<sup>g</sup>RTFO means rolling thin film oven.

<sup>h</sup>PAV means Pressure Aging Vessel.



Do not modify PG modified asphalt binder using polyphosphoric acid.

Crumb rubber must be from automobile and truck tires and must be free from contaminants including fabric, metal, minerals, and other nonrubber substances.

PG modified asphalt binder modified with crumb rubber must be homogeneous and must not contain visible particles of crumb rubber.

The supplier of PG modified asphalt binder modified with crumb rubber must:

1. Report the quantity of crumb rubber by weight of asphalt binder
2. Certify a minimum of 10 percent of crumb rubber by weight of asphalt binder

**FRESNO COUNTY**

**CONTRACT DOCUMENTS**

**AND**

**SPECIFICATIONS**

**FOR THE**

**COUNTY SERVICE AREAS 30 & 32**  
**EL PORVENIR & CANTUA CREEK**  
**COUNTY OF FRESNO WESTSIDE GROUNDWATER PROJECT**

**WELL SITE IMPROVEMENTS & MANGANESE TREATMENT**

**JULY 2023**  
**Prepared for:**



DATE SIGNED 8/18/2023

**FRESNO COUNTY**  
**2281 Tulare Street**  
**Fresno, California 93721**

**Prepared by:**

**EST. 1968**

**PROVOST &  
PRITCHARD**

**CONSULTING GROUP**

*An Employee Owned Company*

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## **SECTION 01 00 05**

### **SPECIFICATIONS**

#### **PART 1 GENERAL**

##### **1.1 GENERAL**

- A. The Contractor shall keep on the job a copy of the Plans and Specifications and shall at all times give the Owner and Engineer access thereto.
- B. Anything mentioned in the Specifications and not shown on the Plans or shown on the Plans and not mentioned in the Specifications shall be of like effect as if shown or mentioned in both.
- C. The Contractor shall not take advantage of any errors, discrepancies or omissions which may exist in the Plans and Specifications but shall immediately call them to the attention of the Engineer whose interpretation or correction thereof shall be conclusive.
- D. Change Orders, supplemental agreements and approved revisions to Plans and Specifications will take precedence over documents listed above. Detailed Plans shall have precedence over general Plans.
- E. Whenever any conflict appears in any portions of the Contract Documents, it shall be resolved by application of the order of precedence.

##### **1.2 GENERAL REQUIREMENTS AND TECHNICAL SPECIFICATIONS**

- A. For definitions of the Specifications categorized as General Requirements and Technical Specifications refer to Section 01 42 13 – Definitions and Abbreviations.

##### **1.3 REFERENCE DOCUMENTS**

- A. For a definition of Reference Documents and State Standard Specifications refer to Section 01 42 13 – Definitions and Abbreviations.
- B. Throughout the following Specification sections, references are made to various widely published, standard and commercial specifications, manuals, or codes of technical societies, organizations, or associations. These specifications are intended to amplify the descriptions of materials, equipment, and construction systems. The Contractor shall caution each of his Subcontractors to become familiar with the contents of the pertinent portions of these Reference Documents. The following Reference Documents are the most widely used, and are cited or referred to in each of the following sections of these Specifications:
  - 1. American Society of Testing Materials (ASTM)
  - 2. American National Standards Institute (ANSI)

3. American Standards Associations (ASA)
  4. American Concrete Institute (ACI)
  5. Federal Specifications, as applicable.
  6. California Building Code
  7. California Plumbing Code
  8. National Electric Code
  9. Construction Safety Orders of the Division of Industrial Relations latest edition.
- C. Each citation of a Reference Document shall be construed to refer to the latest published revision of such specification as of the date of the invitation for bids and to such portions of it that relate and apply directly to the material or installation called for on this job. The Engineer will give no consideration to any claimed ignorance as to what a cited Reference Document contains, since such Subcontractor on a project of this scope is deemed to be experienced and familiar with his own trade to be experienced and familiar with his own trade's generally accepted, published standards of quality.
- D. Whenever references are made to any of the above-mentioned Reference Documents or testing methods in the governing Building Codes, the requirements of those Reference Documents shall govern, insofar as they are not in contravention with maxima or minima prescribed by documents designated in the Building Code.

#### *LIST OF DRAWINGS*

- E. The Work shall conform to the following Drawings:
1. See Sheet No. G-2 of the Plans for sheet index.

#### *1.4 OCCUPATIONAL SAFETY AND HEALTH ACT*

- A. The applicable standards of the American National Standards Institute and the National Fire Protection Association that have been adopted are hereby made a part of these Specifications as a whole and as mentioned in the various sections.
- B. Any errors, ambiguities, or inconsistencies of these standards with either the local codes, the Specifications, or the Drawings shall be brought to the attention of the Engineer.

#### *1.5 COMPLIANCE WITH ALL LAWS AND CODES*

- A. Contractor shall conform to and abide by all local city, county, state and federal laws, rules, regulations, including industrial safety laws. Such laws shall be



considered as essential parts of these Specifications and, in the absence of definite requirements herein, the provisions of such rules and regulations shall be observed by the Contractor. If the Drawings and/or Specifications are at variance therewith, Contractor shall so notify Engineer promptly. Should the Contractor perform any work contrary to such laws, ordinances, rules and regulations he shall bear all costs arising therefrom.

- B. Where these Specifications, however, call for or describe materials workmanship or construction of a better quality, higher standard, or larger size than is required by said rules and regulations, the provisions of these Specifications shall take precedence over said rules and regulations. Contractor shall furnish, without any extra charge, all additional labor or materials, or both, when required for compliance with these rules and regulations.

**END OF SECTION**

## SECTION 01 11 00

### DESCRIPTION OF WORK AND SCHEDULE CONSTRAINTS

#### PART 1 GENERAL

##### 1.1 WORK INCLUDED

- A. The Work consists of furnishing all labor, materials and equipment necessary to construct well site improvements at two communities within Fresno County. The work at each location will consist of the demolition of existing facilities, site grading, furnishing and installation of booster pumps, manganese treatment facilities, hydropneumatic tanks, site electrical facilities and incidentals to complete the work described in the Plans and the Specifications.
- B. The construction site is located in Fresno County near the community of El Porvenir, California (CSA 30) and Canuta Creek, California (CSA 32).
- C. For CSA 30, the primary components are generally described as follows:
  - 1. Demolition of existing surface water treatment and well site facilities
  - 2. Site grading.
  - 3. Booster pump station
  - 4. Hydropneumatic tank
  - 5. Operations building
  - 6. Electrical equipment
  - 7. Instrumentation and control equipment
  - 8. Site piping
- D. For CSA 32, the primary components are generally described as follows:
  - 1. Demolition of existing well site facilities
  - 2. Site grading.
  - 3. Booster pump station
  - 4. Hydropneumatic tank
  - 5. Shade Structure
  - 6. Electrical equipment
  - 7. Instrumentation and control equipment

8. Site piping

1.2 *BEGINNING OF WORK*

- A. The Contractor shall begin work as stated in Section 8-1.04A Start of Job Site Activities.
  - 1. Depending on lead times for materials and equipment, the project may be split into 2 phases:
    - a. First Order of Work: Submittals Phase
    - b. Second Order of Work: Construction Phase

1.3 *TIME OF COMPLETION*

- A. The Contractor shall substantially complete all work as stated in Section 8-1.04A Start of Job Site Activities

1.4 *TIME CONSTRAINTS*

- A. Contractor shall supervise, inspect, and direct the Work competently and apply such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the specific means, methods, techniques, sequence, or procedure of construction required to complete the project as specified by the Contract Documents. Contractor shall be responsible to see that the completed Work complies accurately with the Contract Documents.

1.5 *ORDER OF WORK*

- A. The site improvements do not need to be constructed in any particular order.

**END OF SECTION**

## SECTION 01 11 05

### DESIGN ENGINEER'S STATUS DURING CONSTRUCTION

#### PART 1 GENERAL

##### 1.1 VISITS TO SITE

- A. Design Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Design Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Design Engineer, will determine, in general, if the Work is proceeding in accordance with the Contract Documents..
- B. Design Engineer's visits and observations are subject to all the limitations on Design Engineer's authority and responsibility set forth in Section 1.4, below. Particularly, but without limitation, during or as a result of Design Engineer's visits or observations of Contractor's Work Design Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.
- C. Review of the Work by the Design Engineer shall not relieve the Contractor of the obligation to fulfill all conditions of the Contract.
- D. No oral or telephonic agreement or conversation with any officer, agent or employee of the Owner or the Design Engineer, or with the Design Engineer, either before or after execution of the Contract, shall affect or modify any of the terms or obligations contained in any of the Contract Documents.

##### 1.2 AUTHORIZED VARIATIONS IN WORK

- A. Design Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

##### 1.3 REJECTING DEFECTIVE WORK

- A. Design Engineer will have authority to reject Work which Design Engineer believes to be defective, or that Design Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Design Engineer will also have authority to require

special inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed. Neither this authority nor the Design Engineer's good faith judgment to reject or not reject any work shall subject the Design Engineer to any liability or cause of action by the Contractor, subcontractors, or any other suppliers or persons performing work on the Contract.

#### 1.4 *LIMITATIONS ON ENGINEER'S AUTHORITY AND RESPONSIBILITIES*

- A. Design Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Design Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- B. Design Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- C. Design Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with the Contract Documents.

**END OF SECTION**

**SECTION 01 11 10**  
**COORDINATION OF WORK**

**PART 1 GENERAL**

*1.1 RESPONSIBILITY OF CONTRACTOR*

- A. If any part of the Work depends for proper execution or results upon the work of others, the Contractor shall inspect and promptly report to the Engineer any apparent discrepancies or defects in such work of others that render it unsuitable for such proper execution and results. Failure of the Contractor to so inspect and report shall constitute an acceptance of the work of others as fit and proper except as to defects which may develop in the work of others after execution of the Work by the Contractor.

*1.2 WORK INVOLVED WITH EXISTING SYSTEM*

- A. Existing materials and equipment removed not designated to be salvaged for Owner in the execution of the Work shall become the property of the Contractor and shall be removed from, and disposed of, off the site by the Contractor in an acceptable and lawful manner.

*1.3 COORDINATION OF WORK*

- A. The Contractor shall maintain overall coordination for the execution of the Work. Based on the Construction Schedule prepared in accordance with these Specifications, he/she shall obtain from each of his/her subcontractors a similar schedule and shall be responsible for all parties maintaining these schedules or for coordinating required modifications.

**END OF SECTION**

## SECTION 01 20 00

### MEASUREMENT & PAYMENT

#### PART 1 GENERAL

##### 1.1 MEASUREMENT

- A. Unless otherwise specified in the Contract Documents, quantities of work shall be determined from measurements or dimensions in a horizontal plane. All measurements shall be made in accordance with United States Standard Measures and shall be measured on the basis of “in-place” quantities.
- B. After the work has been completed, the Engineer will make field measurements of unit price items in order to determine the quantities of the various items as a basis for payment. On all unit price items, the contractor will be paid for the actual amount of the work performed in accordance with the contract documents, as computed from field measurements.
- C. Work or quantities not listed in the description of bid items are considered incidental to other construction and will not be measured. Compensation for such incidental work is considered to be included in the various items of work bid.
- D. Contractor will be required to obtain Building, electrical, and plumbing permits from the County of Fresno Development Services Division prior to commencement of the work. The cost of the permits are included in the Project Details. Contractor shall include all costs associated with coordination to obtain permit. Contractor is responsible to pay the fees.

##### 1.2 PARTIAL PAYMENT

- A. Attention is directed to Section 9-1.06 of the State Standard Specifications which, except as modified herein, shall apply in its entirety.
  - 1. The Department shall retain 5 percent of the estimated value of the work done and 5 percent of the value of materials so estimated to have been furnished and delivered and unused or furnished and stored as aforesaid as part security for the fulfillment of the contract by the Contractor. The Department will not hold retention for mobilization or demobilization.
  - 2. Partial payments for materials on hand shall be based upon the value of material delivered on site, properly stored in a secured fenced area subject to, or under the control of, the owner and local agency, and unused. Contractor shall submit copies of invoices of materials to support values. Materials stored shall be installed within 60 days of delivery for payment eligibility.
- B. Payment shall not relieve the Contractor from its obligations under the Contract; nor shall such payment be construed as acceptance of any of the Work. Payment shall not be construed as transfer of ownership of any equipment or materials to the

Owner. Responsibility of ownership shall remain with the Contractor who shall obligated to protect any fully or partially completed work or structure for which payment has been made; or replace any materials or equipment to be provided under the Contract which may be damaged, lost, stolen or otherwise degraded in any way prior to acceptance of the Work, except as provided in Section 7-1.15 of the State Standard Specifications.

1.3 *FINAL PAYMENT*

- A. Refer to State Standard Specifications Section 9-1.17



ESCROW AGREEMENT FOR SECURITY DEPOSITS IN LIEU OF RETENTION

This Escrow Agreement is made and entered into by and between \_\_\_\_\_  
\_\_\_\_\_ whose address is \_\_\_\_\_  
\_\_\_\_\_ herein after called "Owner," \_\_\_\_\_  
\_\_\_\_\_ whose address is \_\_\_\_\_  
\_\_\_\_\_ hereinafter called "Contractor" and \_\_\_\_\_  
\_\_\_\_\_ whose address is \_\_\_\_\_  
\_\_\_\_\_ hereinafter called "Escrow Agent."

For the consideration hereinafter set forth, the Owner, Contractor, and Escrow Agent agree as follows:

(1) Pursuant to Section 22300 of the Public Contract Code of the State of California, Contractor has the option to deposit securities with Escrow Agent as a substitute for retention earnings required to be withheld by Owner pursuant to the Construction Contract entered into between the Owner and Contractor for \_\_\_\_\_ in the amount of \_\_\_\_\_ dated \_\_\_\_\_ (hereinafter referred to as the "Contract"). Alternatively, on written request of the Contractor, the Owner shall make payments of the retention earnings directly to the escrow agent. When the Contractor deposits the securities as a substitute for Contract earnings, the Escrow Agent shall notify the Owner within 10 days of the deposit. The market value of the securities at the time of the substitution shall be at least equal to the cash amount then required to be withheld as retention under the terms of the Contract between the Owner and Contractor. Securities shall be held in the name of \_\_\_\_\_, and shall designate the Contractor as the beneficial owner.

(2) The Owner shall make progress payments to the Contractor for those funds which otherwise would be withheld from progress payments pursuant to the Contract provisions, provided that the Escrow Agent holds securities in the form and amount specified above.

(3) When the Owner makes payment of retentions earned directly to the Escrow Agent, the Escrow Agent shall hold them for the benefit of the Contractor until the time that the escrow created under this contract is terminated. The Contractor may direct the investment of the payments into securities. All terms and conditions of this agreement and the rights and responsibilities of the parties shall be equally applicable and binding when the Owner pays the Escrow Agent directly.

(4) Contractor shall be responsible for paying all fees for the expenses incurred by Escrow Agent in administering the Escrow Account and all expenses of the Owner. These expenses and payment terms shall be determined by the Owner, Contractor, and Escrow Agent.

(5) The interest earned on the securities or the money market accounts held in escrow and all interest earned on that interest shall be for the sole account of Contractor and shall be subject to withdrawal by Contractor at any time and from time to time without notice to the Owner.

(6) Contractor shall have the right to withdraw all or any part of the principal in the Escrow Account only by written notice to Escrow Agent accompanied by written authorization from the Owner to the Escrow Agent that Owner consents to the withdrawal of the amount sought to be withdrawn by Contractor.

(7) The Owner shall have a right to draw upon the securities in the event of default by the Contractor. Upon seven days' written notice to the Escrow Agent from the owner of the default, the Escrow Agent shall immediately convert the securities to cash and shall distribute the cash as instructed by the Owner.

(8) Upon receipt of written notification from the Owner certifying that the Contract is final and complete, and that the Contractor has complied with all requirements and procedures applicable to the Contract, Escrow Agent shall release to Contractor all securities and interest on deposit less escrow fees and charges of the Escrow Account. The escrow shall be closed immediately upon disbursement of all moneys and securities on deposit and payments of fees and charges.

(9) Escrow Agent shall rely on the written notifications from the Owner and the Contractor pursuant to Sections (5) to (8), inclusive, of this agreement and the Owner and Contractor shall hold Escrow Agent harmless from Escrow Agent's release and disbursement of the securities and interest as set forth above.

(10) The names of the persons who are authorized to give written notice or to receive written notice on behalf of the Owner and on behalf of Contractor in connection with the foregoing, and exemplars of their respective signatures are as follows:

On behalf of Owner:

On behalf of Contractor:

On behalf of Escrow Agent:

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

\_\_\_\_\_  
Name

\_\_\_\_\_  
Name

\_\_\_\_\_  
Name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Address

\_\_\_\_\_  
Address

\_\_\_\_\_  
Address

At the time the Escrow Account is opened, the Owner and Contractor shall deliver to the Escrow Agent a fully executed counterpart of this Agreement.

County of Fresno  
Westside Groundwater Project  
CSA 30 & 32 – Well Site Improvements

IN WITNESS WHEREOF, the parties have executed this Agreement by their proper officers on the date first set forth above.

Owner

Contractor

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

\_\_\_\_\_  
Name

\_\_\_\_\_  
Name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Signature

**END OF SECTION**

Measurement & Payment  
01 20 00-5

## SECTION 01 22 00

### EXPLANATION OF BID ITEMS

#### 1. GENERAL

The Contract payment for the specified items of work as set forth in the Bid Schedule shall be full compensation for furnishing all labor, materials, methods or processes, implements, tools, equipment and incidentals and for doing all work involved as required by the provisions of the Contract Documents for a complete in place and operational system.

- A. Unless otherwise specified in the Technical Specifications, quantities of work shall be determined from measurements or dimensions in a horizontal plane. All measurements shall be made in accordance with United States Standard Measures. All materials shall be measured on the basis of “in place” quantities and paid for using the units listed in the bid schedule. For materials specified to be measured in place in a structure, the actual volume within the neat lines of the structure, as shown on the contract drawings, will be the basis for computing quantities.
- B. After the work has been completed, the Engineer will make field measurements of unit price items in order to determine the quantities of the various items as a basis for payment. On all unit price items, the contractor will be paid for the actual amount of the work performed in accordance with the contract documents, as computed from field measurements.
- C. Work or quantities not listed in the description of bid items are considered incidental to other construction and will not be separately measured or paid for.

#### 1.2 CSA 30 BASE BID ITEMS

##### **Bid Item No. 1 - Mobilization, Insurance, and Bonds**

This item is a lump sum bid for mobilization, all necessary bonds, insurance, permits, licenses, fees required during the performance of the work, necessary potholing, and demobilization and shall conform to the provisions of these Specifications. Bid Item No. 1 is intended to cover all of the base “Mobilization” costs for CSA 30.

This item shall consist of covering the Contractors cost for Contract Documents and for the moving of personnel, equipment, supplies and incidentals to the project site. This item shall include obtaining all permits required for the project; except any permits specifically included under a separate bid item. Permit fees and all other permit preparation costs shall be included in this bid item. This item also includes demobilization, including removal of all equipment supplies, personnel, and incidentals from the project site at the end of construction.

All costs associated with this item shall be included in the lump sum price and no additional payment will be made. This bid item shall be paid as specified in Section 9 Payment and Sub-Section 9-1.16D Mobilization of the State Standard Specifications.

### **Bid Item No. 2 - Construction Project Information Sign**

This item is a per each bid for constructing, erecting, maintaining and removing construction project information signs in conformance with the provisions of Section 12-2 of the Special Provisions and the Project Details.

Before any major physical construction work which is readily visible to highway users is started on this contract, the Contractor shall furnish and erect construction project information signs at the locations designated by the Engineer. The signs shall conform to the requirements in the State Standard Specifications, these special provisions, and as directed by the Engineer.

This reconstruction project will require 1 sign, one at County Service Area 30. The Contractor's attention is directed to the "Project Details" of these specifications.

The Contractor shall construct and maintain signage meeting the guidelines specified in the Project Details insert, DWSRF Sign Requirements. The signs shall be prominently displayed in a location visible to the public.

During the course of construction work, the signs shall be kept clean and in good repair by the Contractor. Signs destroyed or damaged by the Contractor's operations shall be replaced at the Contractor's expense.

Upon completion and acceptance of the work, the signs shall remain in place until approved for removal by the Engineer. The Contractor shall be responsible for removing and disposing of the signs after acceptance of the work.

Full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in constructing, maintaining, repairing, and removing construction project information signs shall be included in the unit price bid for Construction Project Information Sign, and no additional payment will be made therefor.

### **Bid Item No. 3 - Job Site Management**

This bid item is a lump sum bid item for the cost of all work involved with CSA 30 job site management and includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in spill prevention and control, material management, waste management, non-stormwater management, and dewatering and identifying, sampling, testing, handling, and disposing of hazardous waste resulting from your activities, as specified in the Standard Specifications and these Special Provisions, and as ordered by the Engineer.

Bid Item No. 3 is intended to cover all of the base "Job Site Management" costs for CSA 30.

The contractor shall abide by all federal and state regulations regarding removal and disposal of hazardous waste materials including, but not limited to asbestos cement pipe.

This item also includes providing worker protection from trench failures and other hazards that may occur during construction. The Contractor shall comply with the provisions of the Construction Safety Orders, Tunnel Safety Orders, and General Safety Orders issued by the State of California Division of Industrial Safety, as well as all other applicable laws, ordinances and regulations, as they pertain to the protection of workers from the hazard of caving ground.

The Contractor shall obtain a permit from the Division of Industrial Safety of the State of California prior to commencement of construction. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of CSA 30 contract work completed.

#### **Bid Item No. 4 - Prepare and Implement Storm Water Pollution Prevention Plan**

This bid item is a lump sum bid for all materials, labor and appurtenances required to prepare and implement a Storm Water Pollution Prevention Plan (“SWPPP”), including preparing the SWPPP, uploading required documents on the SMARTS website, testing, monitoring and all other work associated with implementing the SWPPP and complying with State and Federal permit requirements. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of contract work completed. The County will require only one SWPPP and application to the State Water Resources Control Board for the entire project, however the cost of preparing and implementing it shall be divided equally between Bid Items 4 and 34.

#### **Bid Item No. 5 - Dust Control**

This bid item is a lump sum bid for all materials, labor and appurtenances required to perform dust control measures for the project limits in accordance with conditions of these Specifications. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of contract work completed. The County will require only one dust control plan for the entire project, however the cost of preparing and implementing it shall be divided equally between Bid Items 5 and 36.

#### **Bid Item No. 6 - Traffic Control**

This bid item is a lump sum bid for all materials, labor and appurtenances required to maintain traffic control measures within the CSA 30 project limits in accordance with the Fresno County Encroachment Permit conditions and as directed by the Engineer and County inspector. The Contractor shall submit a traffic control plan for review and approval by the County. The County will require only one traffic control plan for the entire project, however the cost of preparing and implementing it shall be divided equally between Bid Items 6 and 37. Traffic control provisions shall conform to the following requirements:

1. The California Manual on Uniform Traffic Control Devices (MUTCD) and Section 12 of the Special Provisions and Standard Specifications, latest edition, is hereby referred to and incorporated herein as though set forth in full. The Contractor shall be responsible for providing all necessary traffic control facilities, 24 hours per day, 7 days per week for the

entire duration of the project.

2. The Contractor shall maintain pedestrian crossings with adequate visibility for approaching traffic.
3. The Contractor shall notify County Fire and Sheriff Departments, and County Transportation Department and Traffic Division at least forty-eight (48) hours in advance of any proposed lane closure. Any lane closures must have prior approval of the County of Fresno, and have pre-notification warning signs in place seven (7) calendar days prior to said closure.
4. The Contractor shall obtain an encroachment permit and approval of a traffic control plan conforming to the requirements specified herein and the Caltrans encroachment permit requirements for any work encroaching in Caltrans right-of-way or affecting traffic flow in Caltrans right-of-way.
5. The Contractor shall submit a traffic control plan to the County of Fresno for review and approval. A copy of the approved traffic control plan shall be provided to the Engineer prior to the start of construction activities.
6. The Contractor shall strictly comply with, and will be solely responsible for, all required traffic control and devices as per approved plan and any revisions thereof. The Contractor shall inspect the traffic control setup at two-hour intervals, at a minimum, and correct all problems immediately.
7. The Contractor shall provide safe access for the County, County's representatives, and Caltrans (if applicable) inspection staff.
8. Specific traffic control measures associated with the work of this Contract are as follows:
  - a. Existing striping and road stencil work which conflicts with detour layout shall be removed. Conflicting signs shall be covered.
  - b. Where traffic is moved out of its normal position, traffic lanes must be a minimum of eleven (11) feet wide. One (1) lane of traffic in each direction shall be maintained, at all times, unless approved otherwise by the County (and Caltrans).
  - c. All lane closures must be approved by the County (and Caltrans) in advance. The road shall be returned to two-way traffic outside of the hours specified above.
  - d. The Contractor may use trench plates to re-open the road to two-way traffic overnight, however, temporary trench resurfacing shall be placed after each road crossing is complete. Temporary trench resurfacing shall be maintained until permanent trench resurfacing is placed. Permanent trench resurfacing shall be scheduled and placed immediately following acceptance of water installed.
  - e. Access to all local streets, businesses and residences shall be maintained at all times, except as noted below. Where the Contractor's operations block access to driveways, the Contractor shall provide a minimum of forty-eight (48) hour written notice to the residents and minimize the duration of interruptions to driveway access.

Full compensation for furnishing all labor (including flagging), materials, tools, equipment and incidentals, and for doing all work involved for the sole convenience, direction and safety of public traffic and pedestrians shall be included in this bid item. This bid item shall be paid at the

lump sum price bid. Payment will be prorated based on the percentage of contract work completed.

**Bid Item No. 7 - Clearing and Grubbing**

This bid item is a lump sum bid for the cost of all work involved in clearing and grubbing the project site. Areas shall be stripped of surface vegetation, including clearing and grubbing of all trees, vines, stumps, roots, concrete, removing and replacing fencing for site access, debris and unsuitable material, within the project site area including fill slopes, temporarily stockpiling unsuitable material during construction and related work. This bid item shall be paid at the lump sum price bid.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the plans and specifications, and as directed by the Engineer. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of contract work completed.

**Bid Item No. 8 - Site Grading**

This bid item is a lump sum bid for the cost of all earthwork associated with rough and finish grading, including but not limited to, excavation, importing borrow (if required) and exporting and disposing of excess and unsuitable material, over excavation and subgrade preparation and compaction, grading drainage swales, placing and compacting engineered fill to the lines and grades shown on the Plan.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the plans and specifications, and as directed by the Engineer. This bid item will be paid for by a lump sum on a prorated basis based on the percentage of work completed under this bid item.

**Bid Item No. 9 - Site Piping, Valves, and Appurtenances**

This bid item is a lump sum bid for installing all onsite below ground piping and fittings, including trenching, bedding, shading and compaction, backfill and compaction, fencing repair, curb and gutter repair if needed, all on site water distribution pipe, onsite utility water pipe, underground 6-inch SDR 35 PVC gravity sewer main, underground 6-inch DI gravity sewer main, slurry cap, concrete encasement, underground 4-inch backwash piping, polyethylene encasement, tracer wire, caution tape, fittings, on-site valves, utility water service assembly with backflow preventer, valves and valve boxes, testing, video inspection, as shown on the Plans. Completed item shall provide a complete and fully operational on-site system. All above ground pipe and fittings will be excluded from this bid item and specifically included in the bid item to which the above ground pipe and fittings are associated with.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the plans and specifications, and as directed by the Engineer. This bid item will be paid for by Lump Sum on a prorated basis based on the percentage of work



completed under this bid item.

**Bid Item No. 10 - Class 2 Aggregate Base Surfacing**

This bid item is a lump sum bid all work associated placing Class 2 Aggregate Base Surfacing on the site as shown on the Plans. Work in this bid item shall include, but is not limited to, subgrade preparation, obtaining material, placing and compacting aggregate base to the lines and grades shown on the Plans. The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the plans and specifications, and as directed by the Engineer. This bid item will be paid for by a lump sum on a prorated basis based on the percentage of work completed under this bid item.

**Bid Item No. 11 - Chain Link Fence and Access Gates**

This is a lump sum bid item for all work associated with furnishing and installing chain link fence, including excavation, subgrade preparation, backfill & compaction, 6-foot chain link fence, access gates, with privacy slats, three equally spaced strands of barbed wire as indicated in the Plans, and all appurtenances required to enclose the site as indicated in the Plans. Completed item shall provide a complete and fully operational mow strip, & chain link fence with privacy slats system. This bid item will be paid at the unit price bid per lineal foot. Chain link fence associated with the operations building is excluded in this bid item and included as part of Bid Item 20.

**Bid Item No. 12 - Site Electrical, Controls and Lighting**

This bid item is a lump sum bid for all work associated with all electrical equipment required for the El Porvenir (CSA 30) site, including, but not limited to main electrical service, motor control centers (inside building), site lighting, site electrical, transformers, bollards, transfer switch for standby generator, conduit and conductors for all work, and all electrical connections.

Reference is made to the PG&E Service Information in the Project Details of these Specifications. This bid item includes all work associated with the new service with exception to any work identified to be completed by PG&E. The Contractor shall furnish and install all electrical service facilities, including but not limited to conduit and transformer pad and bollards, in conformance with PG&E requirements. Installation of said electrical service facilities will be subject to review and approval by PG&E and the Engineer.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, coordination with PG&E and Building Department, along with all associated appurtenances required to complete electrical, controls and lighting in conformance with the Plans and Specifications and as directed by the Engineer. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of work completed under this bid item.

**Bid Item No. 13 - Standby Generator & Appurtenances**

This bid item is a lump sum bid for a standby generator and controls, including but not limited to, furnishing and installing standby generator, concrete foundation slab, and all appurtenances, testing, and start up.

The Contractor shall submit an application to the San Joaquin Valley Air Pollution Control District, upon approval of the generator submittal by the Engineer, and upon an Authority to Construct (ATC) permit on behalf of the Owner. The Contractor is responsible for paying all fees associated with obtaining said permit.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete standby generator and appurtenances in conformance with the Plans and Specifications, San Joaquin Valley Air Pollution Control District requirements and as directed by the Engineer. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of work completed under this bid item.

**Bid Item No. 14 - Manganese Treatment Unit & Concrete Pad**

This bid item includes pilot testing of the manganese treatment media and all furnishing and installing of four (4) manganese treatment vessels, including filter media, flow meters, associated above ground piping, fittings, pipe supports, valves to and from existing gate valves at the point of connection, concrete foundation and appurtenances for proper function of the treatment system as in the bid documents at CSA 30. Completed item shall provide a complete and fully operational manganese filter system. This bid item will be paid for by Lump Sum following delivery to the project site and completion of installation of unit.

**Bid Item No. 15 - Hydropneumatic Tank**

This bid item is a lump sum bid for all work associated with furnishing and installing a 5,000-gallon hydropneumatic tank and includes tank foundation, hydropneumatic tank, above ground piping, hydropneumatic tank panel including gages, tubing, sight glass, pressure switches/transmitter, heaters, and related equipment and all appurtenances to be furnished with the tank. This bid item also includes an air compressor with concrete pad, and air volume controls designed as to maintain pressure in the hydropneumatic tank. Equipment design shall be coordinated with the hydropneumatic tank supplier to ensure that any required tank penetrations and mounting points are provided by the tank manufacturer prior to shipping. All underground piping required to connect the hydropneumatic tank to the proposed system on both the upstream and downstream side will be excluded from this bid item and included in Bid Item 9.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, shop drawings, along with all associated appurtenances required to complete the work under this bid item, in conformance with the plans and specifications, and as directed by the Engineer. This bid item will be paid for by Lump Sum. Payment will be prorated based on the percentage of work completed under this bid item.

### **Bid Item No. 16 - Booster Pump Station**

This bid item is a lump sum bid and includes furnishing and installing two (2) vertical multi-stage duty pumps and one (1) horizontal end suction high flow pump, including associated controls, appurtenances, above ground pipes and fittings, valves, pressure switches and gages, flow meter, pipe supports, anchorages, reinforced concrete slab foundation, piping connections, testing, and shall be full compensation for furnishing all labor, equipment, and materials to complete the installation as indicated in the Plans and Specifications. Completed item shall provide a complete and fully operational pump station, & appurtenances. All above ground pipe, including the spool pieces that transition from above ground to underground piping, associated with the suction and discharge manifolds on the pump station will be included in this bid item. Any underground piping on the upstream and downstream side of the pump station is excluded in this bid item and included in Bid Item 9.

This bid item will be paid for by Lump Sum on a prorated basis based on the percentage of work completed under this bid item.

### **Bid Item No. 17 - Chlorination Building and Enclosure**

This bid item includes furnishing and installing a chemical enclosure, including associated reinforced concrete foundation, curbs, structural steel, roofing, rafters, fencing, and all labor, equipment, materials, and incidentals necessary for proper completion of the enclosure(s) at CSA 30. This bid item also includes furnishing and installing a chemical storage tank, metering pump, chlorine residual analyzer and associated above ground conduits and above ground tubing, injection and sample taps, valves and accessories, eye wash, hose bibs and racks and appurtenances, sodium hypochlorite solution, for start-up testing, to provide a complete system for injection of sodium hypochlorite solution and monitoring of chlorine residual levels at CSA 30 as shown in the Plans and these Specifications. All underground wet utilities, underground dry utilities, underground chemical feed, and electrical are included in other bid items. Completed item shall provide a complete and fully operational chemical enclosure system. This bid item will be paid for by a Lump Sum, prorated based on the percentage of this item completed.

### **Bid Item No. 18 - Tie-in to Existing Water System**

This bid item is a unit bid item, per each, for all work related to tying into the existing system and includes trenching, bedding, shading and compaction, backfill and compaction, tracer wire, valves and appurtenances, testing, temporary backflow preventer, and inspection to complete the tie in to the existing water system as shown on the Plans. Completed item shall provide a complete and fully operational connection to the existing water system.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the tie-in to the existing water system, in conformance with the Plans and Specifications, and as directed by the Engineer. This bid item shall be paid at the unit price bid per each tie-in to the system.

### **Bid Item No. 19 - Temporary Trench Resurfacing**

This bid item is a unit price bid, per lineal foot, for all work associated with the placement, temporary stamping, maintenance, and removal (prior to the installation of permanent trench

resurfacing) of an estimated quantity of temporary trench resurfacing as designated by the Engineer. All trenching in roadway must be patched each day prior to end of shift. All temporary trench resurfacing within County of Fresno road right of way shall consist of 4 inches of cut-back or “cold-mix” resurfacing in conformance with the County of Fresno Encroachment Permit and Improvement Standards. Temporary trench resurfacing shall be maintained by the Contractor during and after normal working hours and on weekends and holidays. The Contractor shall inspect the condition of the temporary surfacing at sufficient intervals and make repairs as necessary. Temporary trench resurfacing will be paid for only once at any given location.

This bid item shall be paid at the unit price bid per lineal foot for an estimated quantity of trench resurfacing. The estimated quantity for temporary trench resurfacing as shown in the bid schedule shall be the “final pay quantity” and no additional allowance will be made therefore, unless the scope of the work changes.

### **Bid Item No. 20 - Permanent Trench Resurfacing**

This bid item is a unit price bid, per lineal feet, for all work associated with furnishing and installing an estimated quantity of permanent trench resurfacing and stamping. Permanent trench resurfacing shall consist of 7-inch thick asphalt concrete over compacted native material. All permanent trench resurfacing shall be as specified on the Plans and in accordance with the County of Fresno Encroachment Permit and as stated below. The bottom lift of asphalt concrete shall be a 3/4" maximum, course grading mix and upper lift shall be a 1/2" maximum, medium course grading.

The edge of resurfacing for main line trenches shall occur within six (6) inches of the road centerline. If more than 50% of the existing roadway width is disturbed, the entire road shall be resurfaced with an “additional” width to reach the specified limits. In all cases the minimum width of permanent trench resurfacing shall be six (6) inches beyond the sawcut pavement edge. The Contractor shall remove all existing paving to said minimum width. Also, if the edge of resurfacing occurs within two (2) feet of the edge of pavement, lip of gutter or the face of curb, if no gutter is present, the Contractor will remove all existing paving to the edge of pavement, lip of gutter or curb face and resurface to the edge of pavement, lip of gutter or curb face with the applicable trench resurfacing section. The minimum longitudinal distance for such “additional” widths is fifty (50) feet. The minimum distance between these “50 foot” areas is one hundred fifty (150) feet. If two (2) adjacent “50 foot” areas occur closer than the one hundred fifty (150) foot minimum separation requirement, then the entire distance between the areas shall be resurfaced at the additional width.

The Contractor may resurface the required “additional” widths of resurfacing stated above in one of the following two ways:

1. Remove all of the existing paving to the required width limits and resurface with the applicable trench resurfacing section.
2. Grind the existing pavement to a depth of 0.15’ to the required width limits and place 0.15’ overlay over the entire area to be resurfaced. If this option is selected, the 0.15’ overlay will provide 0.15’ of the required thickness for the

trench resurfacing at any given location.

The edge of resurfacing for lateral pipeline trenches and trenches with intersections shall be as specified by the Engineer.

Reference is made to the County of Fresno Standard Specifications and Section 39-5.01 of the Caltrans Standard Specifications. The Contractor shall use a self-propelled paving machine in accordance with the standards stated above to resurface all areas in which pavement was removed associated with the work of this Contract for trenches greater than four (4) feet in width. The Contractor shall use a roller that has a width equal to or less than the width of the trench for all trenches greater than four (4) feet in width.

Any painted traffic stripes, stencil work or pavement markers removed due to trenching or pavement resurfacing shall be repainted or replaced in kind by the Contractor in accordance with County of Fresno Standards. Reference is made to Sections 59, 84-3 and 85 of the Caltrans Standard Specifications. All paint and pavement markers shall be provided by the Contractor.

This bid item shall be paid at the unit price bid per lineal foot for an estimated quantity of permanent trench resurfacing. The estimated quantity for permanent trench resurfacing as shown in the bid schedule shall be the “**final pay quantity**” and no additional allowance will be made therefore, unless the scope of the work changes.

#### **Bid Item No. 21 - Demolish Existing Phase 1 Site Improvements**

This bid item is a lump sum bid for the cost of all work involved in demolition, removal, and disposal of the existing facilities at the project site including the tank and all other facilities under Phase 1 shall be abandoned as specified on the Plans and in these Specifications.

Demolished or removed asbestos concrete pipe shall be properly disposed of offsite at Contractors expense.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the plans and specifications, and as directed by the Engineer. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of work completed under this bid item.

#### **Bid Item No. 22 - Demolish Existing Phase 2 Site Improvements**

This bid item is a lump sum bid for the cost of all work involved in demolition, removal, and disposal of the existing facilities at the project site including the fencing, concrete, package surface water treatment plant, hydropneumatic tank and shade structure, pipes, appurtenances, and all other facilities under Phase 2 shall be abandoned as specified on the Plans and in these Specifications.

Demolished or removed asbestos concrete pipe shall be properly disposed of offsite at Contractors expense.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the plans and specifications, and as directed by the Engineer. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of work completed under this bid item.

**Bid Item No. 23 - Operations Building**

This bid item is a lump sum bid and includes furnishing and installing an operations building, including associated reinforced concrete foundation, metal stud steel structure, mechanical/plumbing, architectural, fencing, and all labor, equipment, materials, and incidentals necessary for proper completion of the building. All underground wet utilities, underground dry utilities, underground chemical feed, and electrical are included in other bid items. Completed item shall provide a complete and fully operational operations building.

The motor control center located inside the building and site conduit and wiring are included in bid item 12. Chain link fencing included in Bid Item 11 is excluded under this bid item.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the plans and specifications, and as directed by the Engineer. This bid item will be paid for by Lump Sum on a prorated basis.

**Bid Item No. 24 - 48” Sanitary Sewer Manhole:**

This bid item is a unit price bid, per manhole, for all work associated with furnishing and installing for all labor, materials, tools, equipment and incidentals required to furnish and install 48” sanitary sewer manholes as shown and specified, including base, riser, cone section, frame and grate, and all other work necessary to result in a complete and operating manhole in accordance with the Plans and Specifications. This bid item will be paid for Per Each.

**Bid Item No. 25 - Drive Approaches**

This bid item is a lump sum bid and includes furnishing and installing drive approaches, including excavation, preparation and compaction of subgrade, furnishing, grading and compacting the granular base material, forming, furnishing the Portland cement concrete, placement, 12-inch hot mix asphalt plug, finishing, 3’x6” and rectangular tubing, and shall be full compensation for furnishing all labor, equipment, and materials to complete the installation as indicated in the Plans and Specifications. Completed item shall provide a complete and fully operational drive approach.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the Plans and Specifications, and as directed by the Engineer. This bid item shall be paid at the unit price bid per each drive approach.

**Bid Item No. 26 - Accessible Parking and Concrete Walkway**

This bid item is a lump sum bid and includes furnishing and installing a American With Disabilities Act (ADA) parking stall, ADA access aisle, curb, ramps, truncated dome surfacing, paint, signage concrete walkway, including excavation, preparation and compaction of subgrade, furnishing, grading and compacting the granular base material, forming, furnishing the Portland cement concrete, placement, finishing and shall be full compensation for furnishing all labor, equipment, and materials to complete the installation as indicated in the Plans and Specifications. Completed item shall provide a complete and fully operational drive approach.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the Plans and Specifications, and as directed by the Engineer. This bid item will be paid for by Lump Sum on a prorated basis.

**Bid Item No. 27 - Destroy Existing CSA 30 Well**

This bid item is a lump sum bid for the cost of all work involved in the destruction of the existing CSA 30 well including but not limited to the work associated with removing the well casing, filling the well, sealing the well to County of Fresno and State well destruction standards, and as directed by Engineer. Completed item shall provide a fully destroyed well per County and State standards.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the Plans and Specifications, in coordination with County of Fresno Environmental Health Department, and as directed by the Engineer. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of work completed under this bid item.

**Bid Item No. 28 - Startup and Testing**

This bid item is a lump sum bid and includes furnishing services associated with startup and testing. Completed bid item shall provide a complete and fully operational facility with complete integration between well, tank, booster pumps and County SCADA system.

This bid item shall include furnishing and operating a temporary portable generator for startup, including providing fuel necessary for startup activities, in the event the new electrical service is not ready at the time of startup.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the Plans and Specifications, and as directed by the Engineer. This bid item will be paid for by Lump Sum on a prorated basis based on the percentage of work completed under this bid item.

**Bid Item No. 29 - Operation and Maintenance Manuals**

This bid item is a lump sum bid and includes preparing and furnishing an operations and

maintenance manuals for all equipment.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the Plans and Specifications, and as directed by the Engineer. This bid item will be paid for by Lump Sum on a prorated basis based on the percentage of work completed under this bid item.

### **Bid Item No. 30 - Record Drawings**

This bid item is a lump sum bid and includes preparing and furnishing record drawings for El Porvenir (CSA 30) improvements.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the Plans and Specifications, and as directed by the Engineer. This bid item will be paid for by Lump Sum on a prorated basis based on the percentage of work completed under this bid item.

### *1.3 CSA 32 BASE BID ITEMS*

### **Bid Item No. 31 - Mobilization, Insurance, and Bonds**

This item is a lump sum bid for mobilization, all necessary bonds, insurance, insurance, permits, licenses, fees required during the performance of the work, and demobilization and shall conform to the provisions of these Specifications. Bid Item No. 31 is intended to cover all of the base “Mobilization” costs for CSA 32.

This item shall consist of covering the Contractors cost for Contract Documents and for the moving of personnel, equipment, supplies and incidentals to the project site. This item shall include obtaining all permits required for the project; except any permits specifically included under a separate bid item. Permit fees and all other permit preparation costs shall be included in this bid item. This item also includes demobilization, including removal of all equipment supplies, personnel, and incidentals from the project site at the end of construction.

All costs associated with this item shall be included in the lump sum price and no additional payment will be made.

### **Bid Item No. 32 - Construction Project Information Sign**

This item is a per each bid for constructing, erecting, maintaining and removing construction project information signs in conformance with the provisions of Section 12-2 of the Special Provisions and the Project Details.

Before any major physical construction work which is readily visible to highway users is started on this contract, the Contractor shall furnish and erect construction project information signs at the locations designated by the Engineer. The signs shall conform to the requirements in the State Standard Specifications, these special provisions, and as directed by the Engineer.



This reconstruction project will require 1 sign, at County Service Area 32. The Contractor's attention is directed to the "Project Details" of these specifications.

The Contractor shall construct and maintain signage meeting the guidelines specified in the Project Details insert, DWSRF Sign Requirements. The signs shall be prominently displayed in a location visible to the public.

During the course of construction work, the signs shall be kept clean and in good repair by the Contractor. Signs destroyed or damaged by the Contractor's operations shall be replaced at the Contractor's expense.

Upon completion and acceptance of the work, the signs shall remain in place until approved for removal by the Engineer. The Contractor shall be responsible for removing and disposing of the signs after acceptance of the work.

Full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in constructing, maintaining, repairing, and removing construction project information signs shall be included in the unit price bid for Construction Project Information Sign, and no additional payment will be made therefor.

### **Bid Item No. 33 - Job Site Management**

This bid item is a lump sum bid item for the cost of all work involved with CSA 32 job site management and includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in spill prevention and control, material management, waste management, non-stormwater management, and dewatering and identifying, sampling, testing, handling, and disposing of hazardous waste resulting from your activities, as specified in the Standard Specifications and these Special Provisions, and as ordered by the Engineer.

Bid Item No. 33 is intended to cover all of the base "Job Site Management" costs for CSA 32.

The contractor shall abide by all federal and state regulations regarding removal and disposal of hazardous materials including, but not limited to asbestos cement pipe.

This item also includes providing worker protection from trench failures and other hazards that may occur during construction. The Contractor shall comply with the provisions of the Construction Safety Orders, Tunnel Safety Orders, and General Safety Orders issued by the State of California Division of Industrial Safety, as well as all other applicable laws, ordinances and regulations, as they pertain to the protection of workers from the hazard of caving ground.

The Contractor shall obtain a permit from the Division of Industrial Safety of the State of California prior to commencement of construction. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of CSA 32 contract work completed.

**Bid Item No. 34 - Prepare and Implement Storm Water Pollution Prevention Plan**

This bid item is a lump sum bid for all materials, labor and appurtenances required to prepare and implement a Storm Water Pollution Prevention Plan (“SWPPP”), including preparing the SWPPP, uploading required documents on the SMARTS website, testing, monitoring and all other work associated with implementing the SWPPP and complying with State and Federal permit requirements. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of contract work completed. The County will require only one SWPPP and application to the State Water Resources Control Board for the entire project, however the cost of preparing and implementing it shall be divided equally between Bid Items 4 and 34.

**Bid Item No. 35 - State Water Resources Control Board – Notice of Intent**

This bid item is specifically provided to reimburse the Contractor for payment of the NOI filing fee charged by the SWRCB and paid by the Contractor after the Contractor has completed the NOI filing process started by the County. The amount paid for this bid item will be the fee only. No payment will be made for overhead or processing costs. Full compensation for any overhead and processing costs will be considered to be included in the various items of work, and no separate compensation will be made therefor.

The dollar amount shown in the Proposal is an estimate only and shall be included in each bidder’s proposal. Payment for this bid item will be adjusted based on the actual fee paid. The provisions of Section 9-1.06 for increased or decreased quantities shall not apply to the “State Water Resources Control Board – Notice of Intent” bid item.

Only one SWRCB NOI will be required for the entire project.

**Bid Item No. 36 - Dust Control**

This bid item is a lump sum bid for all materials, labor and appurtenances required to perform dust control measures for the project limits in accordance with conditions of these Specifications. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of contract work completed. The County will require only one dust control plan for the entire project, however the cost of preparing and implementing it shall be divided equally between Bid Items 5 and 36.

**Bid Item No. 37 - Traffic Control**

This bid item is a lump sum bid for all materials, labor and appurtenances required to maintain traffic control measures within the CSA 32 project limits in accordance with the Fresno County Encroachment Permit conditions and as directed by the Engineer and County inspector. The Contractor shall submit a traffic control plan for review and approval by the County. The County will require only one traffic control plan for the entire project, however the cost of preparing and implementing it shall be divided equally between Bid Items 6 and 37. Traffic control provisions shall conform to the following requirements:

9. The California Manual on Uniform Traffic Control Devices (MUTCD), latest edition, is hereby referred to and incorporated herein as though set forth in full. The Contractor shall

be responsible for providing all necessary traffic control facilities, 24 hours per day, 7 days per week for the entire duration of the project.

10. The Contractor shall maintain pedestrian crossings with adequate visibility for approaching traffic.
11. The Contractor shall notify County Fire and Sheriff Departments, and County Transportation Department and Traffic Division at least forty-eight (48) hours in advance of any proposed lane closure. Any lane closures must have prior approval of the County of Fresno, and have pre-notification warning signs in place seven (7) calendar days prior to said closure.
12. The Contractor shall obtain an encroachment permit and approval of a traffic control plan conforming to the requirements specified herein and the Caltrans encroachment permit requirements for any work encroaching in Caltrans right-of-way or affecting traffic flow in Caltrans right-of-way.
13. The Contractor shall submit a traffic control plan to the County of Fresno (and Caltrans if required) for review and approval. A copy of the approved traffic control plan shall be provided to the Engineer prior to the start of construction activities.
14. The Contractor shall strictly comply with, and will be solely responsible for, all required traffic control and devices as per approved plan and any revisions thereof. The Contractor shall inspect the traffic control setup at two-hour intervals, at a minimum, and correct all problems immediately.
15. The Contractor shall provide safe access for the County, County's representatives, and Caltrans (if applicable) inspection staff.
16. Specific traffic control measures associated with the work of this Contract are as follows:
  - a. Existing striping and road stencil work which conflicts with detour layout shall be removed. Conflicting signs shall be covered.
  - b. Where traffic is moved out of its normal position, traffic lanes must be a minimum of twelve (12) feet wide. One (1) lane of traffic in each direction shall be maintained, at all times, unless approved otherwise by the County (and Caltrans).
  - c. Lane closures shall be limited between the hours of 9 AM to 4 PM to minimize disruptions to commuter traffic. All lane closures must be approved by the County (and Caltrans) in advance. The road shall be returned to two-way traffic outside of the hours specified above.
  - d. The Contractor may use trench plates to re-open the road to two-way traffic overnight, however, temporary trench resurfacing shall be placed after each road crossing is complete. Temporary trench resurfacing shall be maintained until permanent trench resurfacing is placed. Permanent trench resurfacing shall be scheduled and placed immediately following acceptance of water installed.
  - e. Access to all local streets, businesses and residences shall be maintained at all times, except as noted below. Where the Contractor's operations block access to driveways, the Contractor shall provide a minimum of forty-eight (48) hour written notice to the residents and minimize the duration of interruptions to driveway access.

Full compensation for furnishing all labor (including flagging), materials, tools, equipment and incidentals, and for doing all work involved for the sole convenience, direction and safety of public traffic and pedestrians shall be included in this bid item. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of contract work completed.

**Bid Item No. 38 - Clearing and Grubbing**

This bid item is a lump sum bid for the cost of all work involved in clearing and grubbing the project site. Areas shall be stripped of surface vegetation, including clearing and grubbing of all trees, vines, stumps, roots, concrete, removing and replacing fencing for site access, debris and unsuitable material, within the project site area including fill slopes, temporarily stockpiling unsuitable material during construction and related work. This bid item shall be paid at the lump sum price bid.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the plans and specifications, and as directed by the Engineer. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of contract work completed.

**Bid Item No. 39 - Site Grading**

This bid item is a lump sum bid for the cost of all earthwork associated with rough and finish grading, including but not limited to, excavation, importing borrow (if required) and exporting and disposing of excess and unsuitable material, over excavation and subgrade preparation and compaction, grading drainage swales, placing and compacting engineered fill to the lines and grades shown on the Plan.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the plans and specifications, and as directed by the Engineer. This bid item will be paid for by a lump sum on a prorated basis based on the percentage of work completed under this bid item.

**Bid Item No. 40 - Site Piping, Valves, and Appurtenances**

This bid item is a lump sum bid for installing all onsite below ground piping and fittings, including trenching, bedding, shading and compaction, backfill and compaction, all on site water distribution pipe, onsite utility water pipe, underground 4-inch backwash piping, polyethylene encasement, tracer wire, caution tape, fittings, on-site valves, utility water service assembly with backflow preventer, valves and valve boxes, testing, video inspection, as shown on the Plans. Completed item shall provide a complete and fully operational on-site system. All above ground pipe and fittings will be excluded from this bid item and specifically included in the bid item to which the above ground pipe and fittings are associated with.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the plans and specifications, and as directed by the Engineer. This

bid item will be paid for by Lump Sum on a prorated basis based on the percentage of work completed under this bid item.

#### **Bid Item No. 41 - Class 2 Aggregate Base Surfacing**

This bid item is a lump sum bid all work associated placing Class 2 Aggregate Base Surfacing on the site as shown on the Plans. Work in this bid item shall include, but is not limited to, subgrade preparation, placing and compacting aggregate base to the lines and grades shown on the Plans. The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the plans and specifications, and as directed by the Engineer. This bid item will be paid for by a lump sum on a prorated basis based on the percentage of work completed under this bid item.

#### **Bid Item No. 42 - Chain Link Fence and Access Gates**

This is a lump sum bid item for all work associated with furnishing and installing chain link fence, including excavation, subgrade preparation, backfill & compaction, 6-foot chain link fence, access gates, with privacy slats, three equally spaced strands of barbed wire as indicated in the Plans, and all appurtenances required to enclose the site as indicated in the Plans. Completed item shall provide a complete and fully operational mow strip, & chain link fence with privacy slats system. This bid item will be paid at the unit price bid per lineal foot.

#### **Bid Item No. 43 - Control Enclosure**

This bid item is a lump sum bid and includes furnishing and installing a control enclosure at Cantua Creek (CSA 32), including excavation, preparation and compaction of subgrade, furnishing, grading and compacting the granular base material, forming associated reinforced concrete foundation, metal structure, and all labor, equipment, materials, and incidentals necessary for proper completion of the enclosure. Completed item shall provide a complete and fully operational control enclosure.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the Plans and Specifications, and as directed by the Engineer. This bid item will be paid for by Lump Sum on a prorated basis.

#### **Bid Item No. 44 - Site Electrical, Controls and Lighting**

This bid item is a lump sum bid for all work associated with all electrical equipment required for the Cantua Creek (CSA 32) site, including, but not limited to main electrical service, motor control centers (inside building), site lighting, site electrical, transformers, bollards, transfer switch for standby generator, conduit and conductors for all work, and all electrical connections.

Reference is made to the PG&E Service Information in the Project Details of these Specifications. This bid item includes all work associated with the new service with exception to any work identified to be completed by PG&E. The Contractor shall furnish and install all electrical service facilities, including but not limited to conduit and transformer pad and bollards, in conformance with PG&E requirements. Installation of said electrical service facilities will be

subject to review and approval by PG&E and the Engineer.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, coordination with PG&E and Building Department, along with all associated appurtenances required to complete electrical, controls and lighting in conformance with the Plans and Specifications and as directed by the Engineer. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of work completed under this bid item.

#### **Bid Item No. 45 - Standby Generator & Appurtenances**

This bid item is a lump sum bid for a standby generator and controls, including but not limited to, furnishing and installing standby generator, concrete foundation slab, and all appurtenances, testing, and start up.

The Contractor shall submit an application to the San Joaquin Valley Air Pollution Control District, upon approval of the generator submittal by the Engineer, and upon an Authority to Construct (ATC) permit on behalf of the Owner. The Contractor is responsible for paying all fees associated with obtaining said permit.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete standby generator and appurtenances in conformance with the Plans and Specifications, San Joaquin Valley Air Pollution Control District requirements and as directed by the Engineer. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of work completed under this bid item.

#### **Bid Item No. 46 - Manganese Treatment Unit & Concrete Pad**

This bid item includes pilot testing of the manganese treatment media and all furnishing and installing of four (4) manganese treatment vessels, including filter media, flow meters, associated above ground piping, fittings, pipe supports, valves, concrete foundation and appurtenances for proper function of the treatment system as in the bid documents. Completed item shall provide a complete and fully operational manganese filter system. This bid item will be paid for by Lump Sum following delivery to the project site and completion of installation of unit.

#### **Bid Item No. 47 - Hydropneumatic Tank**

This bid item is a lump sum bid for all work associated with furnishing and installing a 5,000-gallon hydropneumatic tank and includes tank foundation, hydropneumatic tank, above ground piping, hydropneumatic tank panel including gages, tubing, sight glass, pressure switches/transmitter, heaters, and related equipment and all appurtenances to be furnished with the tank. This bid item also includes an air compressor with concrete pad, and air volume controls designed as to maintain pressure in the hydropneumatic tank. Equipment design shall be coordinated with the hydropneumatic tank supplier to ensure that any required tank penetrations and mounting points are provided by the tank manufacturer prior to shipping. All underground piping required to connect the hydropneumatic tank to the proposed system on

both the upstream and downstream side will be excluded from this bid item and included in Bid Item 40.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, shop drawings, along with all associated appurtenances required to complete the work under this bid item, in conformance with the plans and specifications, and as directed by the Engineer. This bid item will be paid for by Lump Sum. Payment will be prorated based on the percentage of work completed under this bid item.

#### **Bid Item No. 48 - Booster Pump Station**

This bid item is a lump sum bid and includes furnishing and installing two (2) vertical multi-stage duty pumps and one (1) horizontal end suction high flow pump, including associated controls, appurtenances, above ground pipes and fittings, valves, pressure switches and gages, flow meter, pipe supports, anchorages, reinforced concrete slab foundation, piping connections, testing, and shall be full compensation for furnishing all labor, equipment, and materials to complete the installation as indicated in the Plans and Specifications. Completed item shall provide a complete and fully operational pump station, & appurtenances. All above ground pipe, including the spool pieces that transition from above ground to underground piping, associated with the suction and discharge manifolds on the pump station will be included in this bid item. Any underground piping on the upstream and downstream side of the pump station is excluded in this bid item and included in Bid Item 40.

This bid item will be paid for by Lump Sum on a prorated basis based on the percentage of work completed under this bid item.

#### **Bid Item No. 49 - Chlorination Building and Enclosure**

This bid item includes furnishing and installing a chemical enclosure, including associated reinforced concrete foundation, curbs, structural steel, roofing, rafters, fencing, and all labor, equipment, materials, and incidentals necessary for proper completion of the enclosure(s) at CSA 32. This bid item also includes furnishing and installing a chemical storage tank, metering pump, chlorine residual analyzer and associated above ground conduits and above ground tubing, injection and sample taps, valves and accessories, eye wash, hose bibs and racks and appurtenances, sodium hypochlorite solution, for start-up testing, to provide a complete system for injection of sodium hypochlorite solution and monitoring of chlorine residual levels at CSA 32 as shown in the Plans and these Specifications. All underground wet utilities, underground dry utilities, underground chemical feed, and electrical are included in other bid items. Completed item shall provide a complete and fully operational chemical enclosure system. This bid item will be paid for by a Lump Sum, prorated based on the percentage of this item completed.

#### **Bid Item No. 50 - Tie-in to Existing Water System**

This bid item is a unit bid item, per each, for all work related to tying into the existing system and includes trenching, bedding, shading and compaction, backfill and compaction, tracer wire, valves and appurtenances, testing, temporary backflow preventer, and inspection to complete the tie in to the existing water system as shown on the Plans. Completed item shall provide a complete and fully operational connection to the existing water system.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the tie-in to the existing water system, in conformance with the Plans and Specifications, and as directed by the Engineer. This bid item shall be paid at the unit price bid per each tie-in to the system.

**Bid Item No. 51 - Demolish Existing Phase 1 Site Improvements**

This bid item is a lump sum bid for the cost of all work involved in demolition, removal, and disposal of the existing facilities at the project site including the tank and all other facilities identified under Phase 1 shall be abandoned as specified on the Plans and in these Specifications.

Demolished or removed asbestos concrete pipe shall be properly disposed of offsite at Contractors expense.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the plans and specifications, and as directed by the Engineer. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of work completed under this bid item.

**Bid Item No. 52 - Demolish Existing Phase 2 Site Improvements**

This bid item is a lump sum bid for the cost of all work involved in demolition, removal, and disposal of the existing facilities at the project site including the fencing, concrete, package surface water treatment plant, hydropneumatic tank, pipes, appurtenances, and all other facilities identified under Phase 2 shall be abandoned as specified on the Plans and in these Specifications.

Demolished or removed asbestos concrete pipe shall be properly disposed of offsite at Contractors expense.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the plans and specifications, and as directed by the Engineer. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of work completed under this bid item.

**Bid Item No. 53 - Drive Approaches**

This bid item is a lump sum bid and includes furnishing and installing drive approaches, including excavation, preparation and compaction of subgrade, furnishing, grading and compacting the granular base material, forming, furnishing the Portland cement concrete, placement, 12-inch hot mix asphalt plug, finishing and shall be full compensation for furnishing all labor, equipment, and materials to complete the installation as indicated in the Plans and Specifications. Completed item shall provide a complete and fully operational drive approach.



The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the Plans and Specifications, and as directed by the Engineer. This bid item shall be paid at the unit price bid per each drive approach.

**Bid Item No. 54 - Destroy Existing CSA 32 Well**

This bid item is a lump sum bid for the cost of all work involved in the destruction of the existing CSA 32 well including but not limited to the work associated with removing the well casing, filling the well, sealing the well to County of Fresno and State well destruction standards, and as directed by Engineer. Completed item shall provide a fully destroyed well per County and State standards.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the Plans and Specifications, in coordination with County of Fresno Environmental Health Department, and as directed by the Engineer. This bid item shall be paid at the lump sum price bid. Payment will be prorated based on the percentage of work completed under this bid item

**Bid Item No. 55 - Storm Drain Access Ramp**

This bid item is a lump sum bid for the cost of all earthwork associated with filling existing ramp area and constructing new ramp inside the CSA 32 storm drain pond, including but not limited to, stripping existing vegetation, excavation, importing borrow and exporting and disposing of excess and unsuitable material, over excavation and subgrade preparation and compaction, placing and compacting engineered fill to the lines and grades shown on the Plan.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the plans and specifications, and as directed by the Engineer. This bid item will be paid for by a lump sum on a prorated basis based on the percentage of work completed under this bid item.

**Bid Item No. 56 - Startup and Testing**

This bid item is a lump sum bid and includes furnishing services associated with startup and testing. Completed bid item shall provide a complete and fully operational facility with complete integration between well, tank, booster pumps and County SCADA system.

This bid item shall include furnishing and operating a temporary portable generator for startup, including providing fuel necessary for startup activities, in the event the new electrical service is not ready at the time of startup.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the Plans and Specifications, and as directed by the Engineer. This bid item will be paid for by Lump Sum on a prorated basis based on the percentage of work completed under this bid item.

**Bid Item No. 57 - Operation and Maintenance Manuals**

This bid item is a lump sum bid and includes preparing and furnishing an operations and maintenance manuals for all equipment.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the Plans and Specifications, and as directed by the Engineer. This bid item will be paid for by Lump Sum on a prorated basis based on the percentage of work completed under this bid item.

**Bid Item No. 58 - Record Drawings**

This bid item is a lump sum bid and includes preparing and furnishing record drawings for Cantua Creek (CSA 32) improvements.

The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the work under this bid item, in conformance with the Plans and Specifications, and as directed by the Engineer. This bid item will be paid for by Lump Sum on a prorated basis based on the percentage of work completed under this bid item.

**Bid Item No. 59 - Supplemental Work Allowance**

This item is provided to account for supplemental work which may be required due to differing job site conditions not provided for on the Plans or in these Specifications and other unforeseen work which the Engineer determines is necessary to allow for the work required by the Contract Documents to proceed as intended without interruption. This item will be used only for this purpose. The dollar amount listed on the Bid Proposal Form is an estimated allowance set aside by the Owner and shall be included on each Bidder's Bid Proposal sheets.

Supplemental work shall be performed only upon direct written authorization from the Engineer and daily extra work reports shall be submitted to and approved by the Engineer. The Contractor shall maintain separate records for extra work performed in accordance with the provisions of Section 5-1.27, "Records," of the Standard Specifications and the special provisions.

The Contractor will be paid only for the value of completed supplemental work which has been authorized in writing by the Engineer.

The value of work, which the Owner may authorize under this item, may be less than the amount shown on the Bid Proposal sheet, and it could be that no supplemental work will be authorized at all. Accordingly, payments to the Contractor for supplemental work will likely differ substantially from the estimated Allowance which is included in the Bid Proposal. If no supplemental work is authorized or if no authorized supplemental work is performed, then no payments will be made to the Contractor under this Bid item and the Contract Price will be reduced by the full amount of the item included in the Bid Proposal for supplemental work. The

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provisions in Section 9-1.06, “Changed Quantity Pay Adjustments” of the Standard Specifications shall not apply to the item “Supplemental Work Allowance.”

The value of supplemental work cannot exceed the amount shown on the bid proposal sheet. Additional work that requires compensation exceeding this allowance shall be subject to approval by the contract change order procedures of this Contract.

The Contractor shall have no claim for anticipated overhead or profit should the County fail to authorize any supplemental work or should the value of authorized supplemental work be less than anticipated by the Contractor.

**END OF SECTION**

## SECTION 01 26 13

### REQUESTS FOR INTERPRETATION

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for handling and processing Requests for Interpretation (RFI).
- B. Requests for Interpretation are intended for requesting clarification and interpretation of Contract Documents due to apparent inconsistencies, errors or omissions in the Contract Documents, and due to unanticipated existing conditions.
- C. An RFI which fails to comply with the requirements of this section will be returned to the Contractor for correction without the benefit of the Engineer's response.
- D. No extension of Contract Time will be granted due to the Contractor's failure to transmit an RFI to the Engineer sufficiently in advance of the Work to permit processing.
- E. The Owner reserves the right to assess the Contractor for the costs of the Engineer's response to an RFI which the Owner deems as being frivolous or unnecessary.
- F. The RFI form is provided at the end of this section.

##### 1.2 PROCEDURE

- A. Only after the Contractor has thoroughly reviewed all Contract Documents and other data available to the Contractor, shall the Contractor submit an RFI to the Engineer.
- B. All RFI's shall utilize the provided RFI form noted above and shall indicate which drawings, details, and specifications need clarification. The RFI should be explicit in what interpretation or information is required. Each submitted RFI shall only address a single subject or issue; and shall be numbered in sequence of submittal.
- C. RFI's shall be submitted to the Engineer at least 10 calendar days before a response is needed.
- D. The Engineer will log each received RFI along with the date of receipt and name of the individual submitting.
- E. The Engineer will provide written responses to RFI's within 5 regular working days.

#### PART 2 PRODUCTS

NOT USED

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**PART 3 EXECUTION**

NOT USED

**END OF SECTION**

Requests for Interpretation

01 26 13–2

## REQUEST FOR INFORMATION / INTERPRETATION

Project: \_\_\_\_\_ RFI Number: \_\_\_\_\_

From: \_\_\_\_\_

To: Provost & Pritchard Engineering Group

Date: \_\_\_\_\_

Request: \_\_\_\_\_  
\_\_\_\_\_

Requested Date/Time for Response:

Signed by: \_\_\_\_\_

Response: \_\_\_\_\_  
\_\_\_\_\_

Attachments

Response From: \_\_\_\_\_ To: \_\_\_\_\_ Date Received: \_\_\_\_\_ Date Returned: \_\_\_\_\_

Signed by: \_\_\_\_\_

Copies:  Owner  Consultants  \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_  File

Requests for Interpretation

01 26 13-3

## **SECTION 01 31 19**

### **PROJECT MEETINGS**

#### **PART 1 GENERAL**

##### *1.1 PRECONSTRUCTION CONFERENCE*

- A. Upon approval of the contract or at an earlier time if mutually agreeable, the Engineer will arrange a preconstruction conference to be attended by the Contractor, Contractor's superintendent, the Engineer, and representatives of utilities, major subcontractors, County of Fresno and others involved in the execution of the Work.
- B. The purpose of this conference shall be to establish a working understanding between the parties and to discuss the Construction Schedule, Critical Path Method format required, shop drawing submittals and processing, applications for payment and their processing, and such other subjects as may be pertinent for the execution of the Work.

##### *1.2 PROGRESS MEETINGS*

- A. The Engineer shall arrange and conduct progress meetings. These meetings shall be conducted weekly, unless designated otherwise and shall be attended by the Engineer or his representative, Contractor, Contractor's superintendent and representatives of all subcontractors, utilities, and others, that are active in the execution of the Work. The purpose of these meetings shall be to expedite the work of any subcontractor or other organization that is not up to schedule, resolve conflicts, and in general, coordinate and expedite the execution of the Work.
- B. The agenda of progress meetings shall include review of progress and schedule, of payment request, of the latest Construction Schedule update, and of the record documents.

##### *1.3 PROGRESS AND SCHEDULE REVIEW*

- A. The progress of the Work and the Construction Schedule shall be reviewed to verify:
  - 1. Actual start and finish dates of completed activities since the last progress meeting.
  - 2. Durations and progress of all activities not completed.
  - 3. Reason, time, and cost data for Change Order work that is to be incorporated into the Construction Schedule or payment request form.

4. Payment due to the Contractor based on percentage complete of items in the submitted payment request.
5. Reasons for, and duration of, required revisions in the Construction Schedule.
6. After each monthly update, the Contractor shall submit to the Engineer three (3) prints of the last accepted Construction Schedule, revised in accordance with the monthly review.

#### **1.4 REVIEW OF PAYMENT REQUEST**

- A. The Contractor shall have his copy of the payment request and all other data required by the Contract Documents completed prior to the progress meeting. The Engineer will process Contractor's payment request after satisfactory review of the schedule update.

#### **PART 2 PRODUCTS**

NOT USED

#### **PART 3 EXECUTION**

NOT USED

**END OF SECTION**



**SECTION 01 33 00**  
**SUBMITTAL PROCEDURES**

**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- A. The work described in this section includes general requirements and procedures related to the preparation and transmission of submittals to include Shop Drawings, Samples, Manuals, and Record Drawings

**1.2 RELATED WORK**

- A. General Conditions
- B. Individual equipment specifications

**1.3 GENERAL**

- A. Before submitting a Shop Drawing or Sample, Contractor shall have:
  - 1. Reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
  - 2. Determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
  - 3. Determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
  - 4. Determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
- B. Submit each submittal document under separate cover or transmittal. Transmittal shall include the following identification data, as applicable:
  - 1. Contract number
  - 2. Project name and location
  - 3. Submittal number and revision

4. Product identification
  5. Applicable contract drawing number, specification section, and paragraph number
  6. Stamp Space: Blank space of approximately 2-1/2 inches high by 4 inches wide adjacent to the identification data to receive Engineer's status stamp.
  7. Contractor's certification statement as described below
- C. To each submittal affix the following signed Certification Statement.
1. "Certification Statement: By this submittal, we hereby represent that we have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and pertinent data and we have checked and coordinated each item with other applicable approved drawings and all Contract requirements."
- D. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.
- E. Furnish neat, legible, and sufficiently explicit detail to enable proper review for Contract compliance.
- F. Contractor assumes all risks of error and omission.
- G. Work performed before approval, or not conforming to approved submittals, shall be at Contractor's risk.
- H. Submittal requirements contained in this specification are in addition to specific submittal requirements contained in individual equipment specification sections.

#### 1.4 APPROVAL PROCESS

- A. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
- B. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.

- C. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
- D. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has given Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the Contract Documents and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.
- E. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
- F. Submittals will be returned, marked with one of the following classifications:
  - 1. NO EXCEPTION TAKEN: Requires no corrections, no marks.
  - 2. APPROVED AS NOTED: Requires minor corrections. Items may be fabricated as marked without further resubmission. Resubmit 2 corrected copies to the Engineer.
  - 3. RESUBMIT: Requires corrections. Resubmit entire submittal following original submission with corrections noted. Allow time for checking and Engineer's appropriate action.
  - 4. REJECTED: Requires major corrections or is otherwise not following Contract Documents. No items shall be fabricated. Resubmit entire submittal following original submission with corrections noted.
  - 5. INFORMATION ONLY: Items specified by Contract Documents.

## **PART 2 SUBMITTAL DOCUMENTS**

### **2.1 SHOP DRAWINGS**

- A. Unless otherwise noted in the individual specification sections, submit five (5) sets of shop drawings.
- B. All catalog and specification sheets shall be clearly marked to indicate the specific model number and configuration to be used. Items not applicable to the project shall be crossed out.
- C. Show complete and detailed fabrication; assembly and installation details; wiring and control diagrams; catalog data; pamphlets; descriptive literature; and performance and test data.

- D. Include calculations or other information sufficient to show comprehensive description of structure, equipment, or system provided and its intended manner of use.
- E. Include Manufacturer's installation recommendations.

## 2.2 *SAMPLES*

- A. Unless otherwise noted in the individual specification sections, submit three (3) samples of each item.
- B. Samples shall be representative of the actual material proposed for use in the project and of sufficient size to demonstrate design, color, texture, and finish.
- C. Permanently attach to each sample
  - 1. The contract number
  - 2. Project name and location
  - 3. Product identification
  - 4. Applicable contract drawing and specification section number
  - 5. Subcontractor's, vendor's and/or manufacturer's name, address, and telephone number.
- D. Certain samples may be tested for specific requirements by the Owner and/or Engineer prior to approval. Failure of sample to pass tests will be sufficient cause for refusal to consider further samples of the same brand and make.
- E. Rejected samples will be returned upon request, and resubmittals shall consist of new samples.

## 2.3 *RECORD DRAWINGS*

- A. Maintain 1 record copy of Contract Documents at site in good order and annotated to show revisions made during construction. Keep annotations current for possible inspection.
  - 1. Make record drawings available to Engineer at all times during life of Contract.
  - 2. Drawings: Made part of record drawings and to include:
    - a. Contract Drawings: Annotate or redraft, as required, to show revisions, substitutions, variations, omissions, and discrepancies made or discovered during construction concerning location and depth of utilities, piping, ductbanks, conduits, manholes, pumps, valves, vaults, and other equipment. Make revisions and show on all

drawing views with actual dimensions established to permanent points.

- b. Working/Layout Drawings: When required as submittals, record actual layouts of conduit runs between various items of electrical equipment for power, control, and instrumentation; wire sizes, numbers, and functions; configuration of conduits; piping layouts; and duct layouts. Add sections
3. Before preliminary inspection, furnish reproducible of record drawings. At completion of Contract and before final payment is made, furnish Engineer 1 set of reproducibles of finally approved record drawings reflecting revisions herein described.

#### 2.4 OPERATION AND MAINTENANCE MANUALS

- A. Furnish Operation and Maintenance Manuals for various types of equipment and systems, as required by Contract Documents. Operation and Maintenance Manuals shall be provided for all mechanical and electrical equipment. Unless otherwise indicated, furnish separate manual for each piece of equipment and system. If manual contains other items or equipment, indicate where specified items are located in manual. Include in manual complete information necessary to operate, maintain, and repair specific equipment and system furnished under this Contract, and include the following specific requirements;
  1. Contents.
    - a. Table of Contents and Index.
    - b. Brief description of equipment/system and principal components.
    - c. Starting and stopping procedures, both normal and emergency.
    - d. Installation, maintenance, and overhaul instructions including detailed assembly drawings with parts list and numbers, and recommended spare parts list with recommended quantity, manufacturer's price, supplier's address, and telephone number.
    - e. Recommended schedule for servicing, including technical data sheets that indicate weights and types of oil, grease, or other lubricants recommended for use and their application procedures.
    - f. One copy of each component wiring diagram and system wiring diagram showing wire size and identification.
    - g. One approved copy of each submittal with changes made during construction properly noted, including test certificates, characteristic curves, factory and field test results.



## SECTION 01 35 00

### MATERIAL SUBSTITUTION PROCEDURES

#### PART 1 GENERAL

##### 1.1 GENERAL

- A. The materials furnished and used shall be new, except as may be provided elsewhere in these Specifications, or on the Plans.
- B. All materials required to complete the work under this contract shall be furnished by the Contractor, unless otherwise stated.
- C. It shall be the duty of the Contractor to call the Engineer's attention to apparent errors or omissions and request instruction before proceeding with the Work. The Engineer may, by appropriate instructions, correct said apparent errors and omissions, which instructions shall be as binding upon the Contractor as though contained in the original Contract Documents.

##### 1.2 DEFINITIONS

- A. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor.
- B. Revisions: Changes to Contract Documents requested by Owner or Engineer.
- C. Options: Specified options of products and construction methods included in Contract Documents.

##### 1.3 TRADE NAMES AND ALTERNATIVES

- A. Wherever an article, or any class of materials, is specified by the trade name or by the name of any particular patentee, manufacturer or dealer, or by reference to the catalog of any such manufacturer or dealer, it shall be taken as intending to mean and specify the article or material described or any other equal thereto in quality, finish and durability, and equally as serviceable for the purpose for which it is or they are intended. The intent of the Plans and Specifications is to specify highest grade standard equipment, and it is not the intent of these Plans and Specifications to exclude or omit the products of any responsible manufacturer, if such products are equal in every practical respect to those mentioned herein, as determined by the Engineer.

##### 1.4 SAMPLES

- A. At the option of the Engineer, the source of supply of materials for the Work shall be subject to tests and inspection before the delivery is started and before such

materials are used in the Work. Samples representative of the character and quality of materials shall be submitted by the Contractor. Samples shall be of sufficient quantities or amounts for testing or examination.

- B. All tests of materials furnished by the Contractor shall be made in accordance with the commonly recognized standards of national technical organizations, and such special methods and tests as are prescribed in the Contract Documents.
- C. The Contractor shall furnish such samples of materials as are requested by the Engineer, without charge. No material shall be used until the Engineer has had the opportunity to test or examine such materials. Samples will be secured and tested whenever necessary to determine the quality of the material. Samples and test specimens prepared at the jobsite, such as concrete test cylinders, shall be taken or prepared by the Engineer, or his designated representative, in the presence and with the assistance of the Contractor.

#### 1.5 SUBMITTALS

- A. Material Submittals shall be made in accordance with Caltrans Standard Specifications Section 5-1.23 and Section 01 33 00 – of these specifications.

#### 1.6 INSPECTION OF MATERIALS BY THE CONTRACTOR

- A. Contractor shall make a close inspection of all materials as delivered, and shall promptly return all defective materials without waiting for their rejection by the Engineer.

#### 1.7 CERTIFICATES OF COMPLIANCE

- A. A Certificate of Compliance may be required for certain materials and equipment that become final products of the completed Work. Certificates of Compliance shall be furnished prior to the use of any materials for which these Specifications require that such a certificate be furnished. In addition, when so authorized in these Specifications, the Engineer may permit the use of certain materials or assemblies prior to sampling and testing if accompanied by a Certificate of Compliance.
- B. The Certificate shall be signed by the manufacturer of the material or the manufacturer of assembled materials and shall state that the materials involved comply in all respects with the requirements of the Specifications.
- C. A Certificate of Compliance shall be furnished with each lot of material delivered to the Work and the lot so certified shall be clearly identified in the certificate.
- D. All materials used on the basis of a Certificate of Compliance may be sampled and tested at any time. The fact that material is used on the basis of a Certificate of Compliance shall not relieve the Contractor of responsibility for incorporating material in the Work which conforms to the requirements of the Plans and Specifications and any such material not conforming to such requirements will be subject to rejection whether in place or not.



- E. The County of Fresno reserves the right to refuse to permit the use of material on the basis of a Certificate of Compliance.
  - 1. The form of the Certificate of Compliance and its disposition shall be as directed by the Engineer.

#### 1.8 MANUFACTURER TESTING

- A. At the option of the Engineer, materials and equipment to be supplied under this Contract will be tested and inspected either at their place of origin or at the site of the Work. The Contractor shall give the Engineer written notification well in advance of actual readiness of materials and equipment to be tested and inspected at point of origin.
  - 1. Satisfactory tests and inspections at the point of origin shall not be construed as a final acceptance of the materials and equipment nor shall such tests and inspections preclude retesting or re-inspection at the site of the Work.
  - 2. Materials and equipment which will require testing and inspection at the place of origin shall not be shipped prior to such testing and inspection.

#### 1.9 MANUFACTURERS' RECOMMENDATIONS

- A. All equipment specified and used in the project shall be installed in accordance with the approved manufacturer's current written recommendations.
- B. All such equipment, material, etc., shall be of the manufacturer's latest system or line.

#### 1.10 SUBSTITUTIONS

- A. Conditions: Contractor's substitutions shall be considered when one or more conditions are satisfied, as determined by the Engineer. (The Contractor's submittal and Engineer's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.)
  - 1. Extensive revisions to Contract Documents are not required.
  - 2. Proposed changes are in keeping with the general intent of the Contract Documents.
  - 3. Request is timely, fully documented and properly submitted.
  - 4. Request is directly related to an "or equal" clause or similar language in the Contract Documents.

5. The specified product or method of construction cannot be provided within the Contract Time. The request shall not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
6. The specified product or method of construction cannot receive necessary approval by governing authority, and the requested substitution can.
7. Substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear.
  - a. Additional responsibilities for the Owner may include additional compensation to the Engineer for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.
  - b. Contractor shall provide all data in support of any proposed substitute or “or-equal” at Contractor’s expense.
8. Specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
9. Specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.
10. Specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provide the required warranty.

#### **1.11 SUBSTITUTION REQUEST FORM**

- A. Use Substitution Request Form in on page 01 35 00-5.
- B. Submit one form (4 copies) for each request.

**END OF SECTION**

## SUBSTITUTION REQUEST FORM

Page 1 of 2

**TO:** \_\_\_\_\_

**PROJECT:** \_\_\_\_\_

We hereby submit for your consideration the following product instead of the specified item for the above project:

SECTION:	PARAGRAPH:	SPECIFIED ITEM:

Proposed Substitution: \_\_\_\_\_  
\_\_\_\_\_

- Attach: 1) Complete technical data, including laboratory tests, if applicable.  
2) Complete information on changes to Drawings and/or Specifications which proposed substitution will require for its proper installation.

A. Does the substitution affect dimensions on Drawings?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

B. Will the undersigned pay for changes to the project design, including engineering and detailing costs caused by the requested substitution?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

C. What affect does substitution have on other trades?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

D. Differences between proposed substitution and specified item?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

E. Manufacturer's guarantees of the proposed and specified items are:

\_\_\_\_ Same      \_\_\_\_\_ Different (explain on attached sheet)

Material Substitutions Procedures  
01 35 00-5

## SUBSTITUTION REQUEST FORM

Page 2 of 2

The undersigned states that the function, appearance and quality are equivalent or superior to the specified item.

Submitted By:

Signature \_\_\_\_\_

Firm \_\_\_\_\_

Address \_\_\_\_\_

Date \_\_\_\_\_

Telephone \_\_\_\_\_

For Use by Design Consultant
Accepted Accepted as Noted Not Accepted Received Late By _____
Date _____
Remarks _____

## **SECTION 01 35 43**

### **ENVIRONMENTAL PROCEDURES**

#### **PART 1 GENERAL**

##### **1.1 GENERAL**

- A. The Contractor shall implement the environmental mitigation measures described in the following sections, excepting those measures specifically identified to be completed by the Owner.

##### **1.2 RELATED WORK**

- A. Not used.

##### **1.3 CULTURAL RESOURCES**

- A. If archaeological features or materials are unearthed during any phase of project activities, activities within fifty (50) feet of the find shall cease until Contractor has contacted the California State Historic Preservation Office (SHPO), and the significance of the resource has been evaluated. Any mitigation measures that may be deemed necessary must have the approval of SHPO, and shall be implemented, pursuant to the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation, 48 CFR 44716, by a "qualified" archaeologist representing the Contractor prior to the resumption of construction activities.
- B. If human remains are exposed by activity related to the project, the Contractor shall comply with California State Health and Safety Code, Section 7050.5, which states that no further disturbance shall occur until the County Coroner has made the necessary findings as to origin and disposition pursuant to California Public Resources Code, Section 5097.98.

##### **1.4 BIOLOGICAL RESOURCES**

- A. No evidence of threatened or endangered species has been found on the project site; however, several threatened or endangered species are known to reside in the general area surrounding the project site. If any evidence of threatened and endangered species is observed during the course of construction, the Contractor shall notify the Owner immediately.

##### **1.5 AIR QUALITY**

- A. Contractor shall abide to all applicable state, federal, and local codes and regulations for fugitive dust management and control. Refer to Section 01 57 27 – Dust Control for Air Quality mitigation measure requirements.

1.6 *HYDROLOGY AND WATER QUALITY*

- A. Contractor shall abide to all applicable state, federal, and local codes and regulations for storm water management and control. Refer to Section 13 of the County of Fresno Specifications – Water Pollution Control mitigation measurement requirements.

**END OF SECTION**

## SECTION 01 42 13

### DEFINITIONS AND ABBREVIATIONS

#### PART 1 GENERAL

1.1 *DEFINITIONS AND TERMS* – IN THE EVENT THAT THESE DEFINITIONS CONFLICT WITH THE DEFINITIONS IN SECTION 1-1.07, THE DEFINITIONS IN SECTION 1-1.07 SHALL PREVAIL.

A. Whenever in these Specifications, or in other Contract Documents, the following terms are used, the intent and meaning shall be interpreted as follows:

1. Board: Board of Directors, Fresno County.
2. Calendar Day: Every day shown on the calendar.
3. Contractor: The word “Contractor” means the person, firm or corporation to whom the award is made. Subcontractors as such will not be recognized.
4. Contract Price: The total amount of money for which the Contract is awarded.
5. Contract Unit Price: The Contractor’s original bid for a single unit of an item of work in the Proposal.
6. Contract Time: The number of calendar days for completion of the Work, including authorized time extensions. In the event a calendar date is specified for Project completion in lieu of a number of calendar days, the Work shall be completed by that calendar date. The Contract Time shall be computed by excluding the first and including the last day; and if the last day be Sunday or a legal holiday, that shall be excluded.
7. Design Engineer: Provost and Pritchard.
8. Engineer: County of Fresno Director of Public Works and Planning, and/or his designee.
9. Equipment: (Construction) - All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and also tools and apparatus necessary for the proper construction and acceptable completion of work. (Installed) - All material or articles used in equipping a facility as furnishings or apparatus to fulfill a functional design.
10. General Conditions: As specified in Section 00 72 00 – General Conditions.
11. General Requirements: All specifications contained in Division 1.

12. Notice: Any notice allowed or required to be given by the Owner may be given by the Engineer.
13. Owner: Fresno County
14. Person: Any individual, association, partnership, corporation, trust, joint venture or other legal entity.
15. Plans: The drawings, profiles, cross-sections, working drawings and supplemental drawings, or reproduction thereof, approved by the Engineer, which show the location, character, dimensions or details of the work.
16. Proposal: The offer of a Bidder when submitted on the Proposal form; properly signed and guaranteed.
17. Reference Documents: Bulletins, Rules, Methods of Analysis or Test, Codes, Standards, and Specifications of public or private agencies, Engineer Societies, or Industrial Associations. Reference shall be to the latest edition thereof, including Amendments, which are in effect and published at the time the Request for Bids is issued, unless a specific edition is identified, in which case reference shall be to such specific edition. Reference Documents are intended to amplify the descriptions of materials, equipment, and construction systems and are to be considered a part of the Contract Documents insofar as the various sections thereof are referred to hereinafter. Examples of Reference Documents are Federal Specifications, State Standard Specifications, and those of American Society of Testing Materials (ASTM), American National Standards Institute (ANSI), American Standards Associations (ASA), and American Concrete Institute (ACI).
18. Salvage: The protection storage, and/or removal of specified existing equipment, parts or materials during the work for retention and later use by the Owner.
19. Sanitary Sewer: Any conduit and appurtenances intended for the reception and transfer of sewage.
20. Specifications: Any or all of the specifications defined in this section and any addendums thereof. They are divided into four general categories: Contract and Bidding Requirements (All divisions of Caltrans State Standard Specifications), General Requirements (Division 1), Technical Specifications (Division 2 through Division 46), and Reference Documents.
21. State: The State of California.
22. State Standard Plans: State of California, Business and Transportation Agency, Department of Transportation, Caltrans, Standard Plans, latest revision.



23. State Standard Specifications: Standard Specifications for the project are those entitled "Standard Specifications, State of California, Business and Transportation Agency, Department of Transportation", 2015 edition, hereinafter referred to as the State Standard Specifications. These Specifications are to be considered a part of the Contract Documents insofar as they are not superseded by other provisions contained in Divisions 0 through 2 and 33 of these Specifications.
24. Storm Sewer: Any conduit and appurtenances intended for the reception and transfer of storm water.
25. Street: Any public road, highway, parkway, freeway, alley, walk or right-of-way.
26. Surety: Any individual, firm or corporation bound with and for the Contractor for the acceptable performance, execution and completion of the Work, and for the satisfaction of all obligations incurred.
27. Utility: Tracks, overhead or underground wires, pipelines, conduits, ducts or structures, sewers of storm drains owned, operated or maintained in or across a public right-of-way or private easement.
28. Water Main: Any conduit and appurtenances intended for the distribution of water.
29. Working Day: Any weekday (Monday through Friday), not a designated national holiday, during which weather allows the Contractor to work four or more hours consecutively, starting no later than 10:00 AM.

## 1.2 REFERENCED STANDARDS

- A. The standards referred to, except as modified, shall have full force and effect as though printed in this Specification, and shall be the latest edition or revision thereof in effect on the bid opening date, unless a particular edition or issue is indicated. Copies of these standards are not available from the Owner. The Engineer will furnish, upon request, information as to how copies may be obtained.

## 1.3 LIST OF ABBREVIATIONS

- A. Abbreviations and terms, or pronouns in place of them, shall be interpreted as follows:

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ABMA	American Boiler Manufacturers Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
ADC	Air Diffusion Council

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AEIC	Association of Edison Illuminating Companies
AFBMA	Antifriction Bearing Manufacturers Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AI	Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
ARI	American Refrigeration Institute
ASA	(now U.S.A.S.I., USA Standards Institute) Association & its Standard Specifications
ASAHC	American Society of Architectural Hardware Consultants
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWG	American Wire Gage
AWI	Architectural Woodwork Institute
AWPA	American Wood-Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Institute of America (formerly SCPI)
CAL/OSHA	California Occupational Safety and Health Administration
CALTRANS	California Department of Transportation
CBC	California Building Code
CCR	California Codes of Regulations
CDA	Copper Development Association
CEC	California Electrical Code
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CMC	California Mechanical Code
CPC	California Plumbing Code
CRA	California Redwood Association
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard (U.S. Department of Commerce)
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
EI	Edison Electric Institute

Definitions and Abbreviations  
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EJCDC	Engineers' Joint Contract Documents Committee
EPA	Environmental Protection Agency
FED SPEC	Federal Specification
FCI	Fluid Controls Institute
FGMA	Flat Glass Marketing Association
FIA	Factory Insurance Association
FM	Factory Mutual
FSA	Fluid Sealing Association
FTI	Facing Tile Institute
HEI	Heat Exchange Institute
HMI	Hoist Manufacturers Institute
HPMA	Hardwood Plywood Manufacturers Association
HTI	Hand Tools Institute
ICBO	International Conference of Building Officials
I-B-R	Institute of Boiler and Radiator Manufacturers
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IFI	Industrial Fasteners Institute
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
JIC	Joint International Conference (Hydraulic Institute)
MHI	Materials Handling Institute
MIL	Military Specification
MMA	Monorail Manufacturers Association
MSS	Manufacturers' Standardization Society
NAAMM	National Association of Architectural Metals Manufacturers
NACE	National Association of Corrosion Engineers.
MBBPVI	National Board of Boiler and Pressure Vessel Inspectors
NBHA	National Builders Hardware Association
NCSPA	National Corrugated Steel Pipe Association
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NEMI	National Elevator Manufacturing Industry
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NLA	National Lime Association
NPC	National Plumbing Code
NPT	National Pipe Thread
NRCA	National Roofing Contractors' Association
NRMCA	National Ready Mixed Concrete Association
NSC	National Safety Council
NSF	National Sanitation Foundation
NTMA	National Terrazzo and Mosaic Association
NWMA	National Woodwork Manufacturers Association
OSHA	Occupational Safety and Health Administration

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PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PDI	Plumbing and Drainage Institute
PFI	Pipe Fabrication Institute
PS	Product Standard
RTI	Resilient Tile Institute (formerly AVATI)
SAE	Society of Automotive Engineers
SCPRF	Structural Clay Products Research Foundation
SI	International Systems of Units (Metric)
SIGMA	Sealed Insulating Glass Manufacturers Association
SFPA	Southern Forest Products Association
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPFA	Steel Plate Fabricators Association
SPI	Society of the Plastics Industry
SPTA	Southern Pressure Treaters Association
SSI	Scaffolding and Shoring Institute
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction (Greenbook)
UL	Underwriters' Laboratories
UPC	Uniform Plumbing Code
USBR	U.S. Bureau of Reclamation
USGS	United States Geological Survey
WCLA	West Coast Lumbermen's Association (Std. Grading and Dressing Rule)
WCLIB	West Coast Lumber Inspection Bureau
WIC	Woodwork Institute of California
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

**END OF SECTION**

## **SECTION 01 43 00**

### **QUALITY CONTROL AND TESTING**

#### **PART 1 GENERAL**

##### **1.1 NOTICE OF DEFECTS**

- A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- B. All defective Work may be rejected, corrected, or accepted, at the discretion of the Owner and Engineer.

##### **1.2 ACCESS TO WORK**

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests shall have access to the Site and the Work at reasonable times for their observation, inspecting, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's Site safety procedures and programs so that they may comply therewith.

##### **1.3 MATERIALS AND EQUIPMENT**

- A. Materials and equipment shall be subject to the requirements of Section 01 35 00.

##### **1.4 PROJECT SITE TESTING**

- A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.
- B. Except for specified material suitability tests, all initial routine tests of materials shall be at the expense of the Owner and shall be performed by an independent certified laboratory designated by the Owner. Whenever a specified percent relative compaction test is required and the material or portion thereof so tested fails to meet or exceed the relative compaction specified, all subsequent retesting shall be performed at the expense of the Contractor.
- C. All material suitability tests shall be at the expense of the Contractor. Testing shall be by an independent certified laboratory approved by the Engineer.

##### **1.5 TEST STANDARDS**

- A. All sampling, specimen preparation, and testing of materials shall be in accordance with the standards of nationally recognized technical organizations.

- B. The physical characteristics of all materials not particularly specified shall conform to the latest standards published by the ASTM, where applicable.

#### 1.6 UNCOVERING WORK

- A. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without concurrence of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and recovered at Contractor's expense.
- B. If Engineer considers it necessary or advisable that covered Work be re-observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.
  - 1. If it is found that the uncovered Work is defective, Contractor shall promptly correct said defects, including all work involved in uncovering and recovering the work, at no cost to the Owner.
  - 2. If, the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction.

#### 1.7 CORRECTION OR REMOVAL OF DEFECTIVE OR REJECTED WORK

- A. Upon receipt of notice, Contractor shall correct all defective or rejected Work and replace it with Work that is not defective, at no cost to the Owner.

#### 1.8 ACCEPTANCE OF DEFECTIVE WORK

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so.
  - 1. If any such acceptance occurs, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted.
  - 2. Engineer shall determine the reasonableness of the diminished value of Work so accepted and Contractor shall pay all costs involved in making such determination.

**END OF SECTION**

**SECTION 01 50 00**  
**TEMPORARY FACILITIES**

**PART 1 GENERAL**

**1.1 GENERAL**

- A. The Contractor shall provide all temporary facilities and utilities required for completion of the Work as well as safety precautions and programs. No attempt is made to set out in detail the Contractor's means or methods necessary to accomplish the tasks involved.

**1.2 TEMPORARY UTILITIES**

A. Water

1. Water used for human consumption shall be kept free from contamination and shall conform to the requirements of the State and local authorities for potable water.

B. Sanitary Facilities

1. The Contractor shall provide suitable and adequate sanitary conveniences for the use his staff at the site of the Work. Such conveniences shall include chemical toilets or water closets and shall be located at appropriate locations at the site of the Work. All sanitary conveniences shall conform to the regulations of the public authority having jurisdiction over such matters. At the completion of the Work, all such sanitary conveniences shall be removed and the site left in a sanitary condition.
2. With respect to sanitation facilities, the Contractor shall cooperate with and follow directions of representatives of the Public Health Service and the State. State and County Public Health Service representatives shall have access to the Work, whether it is in preparation or progress, and the Contractor shall provide facilities for such access and inspection.

**1.3 TEMPORARY CONSTRUCTION FACILITIES**

- A. Construction hoists, shoring, and similar temporary facilities shall be of ample size and capacity to adequately support and move the loads to which they will be subjected. Railings, enclosures, safety devices, and controls required by law or for adequate protection of life and property shall be provided.
- B. Temporary supports shall be designed with an adequate safety factor to assure adequate load bearing capability. The Contractor shall submit design calculations prepared by a professional registered engineer for staging and shoring prior to application of loads.

- C. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations from one hour before sunset each day to one hour after sunrise of the next day until such excavation is entirely refilled, compacted, and paved. All excavations shall be barricaded in such a manner as to prevent person from falling, walking, or otherwise entering any excavation in any street, roadway, parking lot, treatment plant, or any other area, public or private.
- D. The Contractor shall adequately identify and guard all hazardous areas and conditions by visual warning devices and, where necessary, physical barriers. Such devices shall, as a minimum, conform to the requirements of Cal/OSHA.
- E. At such time or times any temporary construction facilities and utilities are no longer required for the work, the Contractor shall notify the Engineer of his intent and schedule for removal of the temporary facilities and utilities, and obtain the Engineer's approval before removing the same. As approved, the Contractor shall remove the temporary facilities and utilities from the site as his property and leave the site in such condition as specified, as directed by the Engineer, and/or as indicated on the Plans.

#### 1.4 ACCESS ROADS AND STAGING AREA

- A. Adequate access shall be maintained to all storage areas and other areas to which frequent access is required. The Contractor shall limit the location of his storage of equipment and materials outside of the project site. The Contractor shall make his own arrangements for space that may be required and bear all associated costs. The Contractor shall provide any temporary storage required for the protection of equipment and materials as recommended by manufacturers of such materials.
- B. Storage and protection:
  - 1. Materials and equipment shall be stored in accordance with supplier's written instructions, with seals and labels intact and legible. Exposed metal surfaces of valves, fittings and similar materials shall be coated with accordance with manufacturer's recommendations to prevent corrosion.
  - 2. Storage shall be arranged to provide access for inspection. The Contractor shall periodically inspect to assure materials and equipment are undamaged and are maintained under required conditions.

**END OF SECTION**



## **SECTION 01 51 36**

### **WATERING**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. The work of this section consists of furnishing, hauling, and applying water required for compaction of embankments, backfills, subgrade, and base course, and other construction operation.

##### **1.2 RELATED WORK**

- A. Section 01 50 00 – Temporary Facilities
- B. Section 01 57 27 – Dust Control

##### **1.3 REFERENCES**

- A. Section 17 - Watering, State Standard Specifications

#### **PART 2 PRODUCTS**

##### **2.1 WATER**

- A. Free of debris, organic matter, and other objectionable substances.

#### **PART 3 EXECUTION**

##### **3.1 WATER TRUCK**

- A. At least 1,000-gallon capacity.
- B. Keep at least one water truck on site at all times, unless Engineer approves removal of the truck from the site before final completion.

##### **3.2 APPLICATION**

- A. Use pressure type distributors or a pipeline equipped with sprinkler system. Provide approved meter devices near points of discharge.
- B. Ensure a uniform application of water for optimum moisture content. Avoid excessive runoff and minimize water waste.
- C. The Contractor may water excavation areas before excavating. Drill full depth of excavation to make moisture determinations.

- D. If over watering occurs, de-water at no additional expense to the Owner.

### 3.3 SPECIAL CONTROLS

The Contractor shall take all reasonable means to minimize inconvenience and injury to the public by dust, noise, diversion of storm water, or other agencies under his control.

#### A. Dust Control

- 1. As specified in Section 01 57 27 – Dust Control

#### B. Water

- 1. The Contractor will not be allowed to use water for Construction from the CSA 30 or CSA 32 water systems. The existing water systems do not have sufficient capacity to supply any water for construction, including dust control.
- 2. The Owner can furnish potable water for flushing and testing only, from the existing CSA 30 and CSA 32 water distribution systems via fire hydrants. The Contractor shall be responsible for furnishing and installing a connection to each fire hydrant, flow meter with totalizer, pump, portable tank, and all necessary piping and appurtenances necessary for water pipeline flushing, filling, testing, and disinfection procedures only. Contractor is hereby made aware of the Districts' limitation to provide potable water at certain times of the day and up to a certain amount. It is expected that the Districts will be able to provide water to fill and flush the pipelines equivalent to 2 pipe volumes of up to 1,000 lineal feet of pipeline (approximately 5,000 gallons at the time) before the storage tank must be replenished for the next flushing cycle. The Contractor shall anticipate performing the disinfection and flushing procedures only during off-peak hours, demand times potentially from the hours of 11:00 AM to 3:00 PM, or as directed by the County's Operator. If the Contractor elects to utilize distribution system water, the Contractor will be charged \$400 per acre-foot of water. The Contractor's bid proposal shall include all costs associated with purchase of water for the project. The Contractor shall coordinate with the County Operator for obtaining water during the allowed off-peak hours. It shall be the responsibility of the Contractor to furnish and install all required equipment necessary to deliver water from the Owner's source.
- 3. At the Contractor's option, the Contractor may use a Certified Water Hauler to supply potable water for initial filling, flushing, and testing of the new water distribution system. The Contractor is responsible for securing disinfected water that meets drinking water standards.
- 4. The Contractor shall make all arrangements to obtain water for construction from sources other than the County.

5. Water used for human consumption shall be kept free from contamination and shall conform to the requirements of the State and local authorities for potable water.
6. The Contractor shall obtain approval from the County for use of any non-potable well water used during construction.
7. Full compensation for furnishing all labor, materials, tools and equipment and for doing all work involved in furnishing and applying water as required by the Contract Documents and Specifications, State Standard Specifications, shall be considered as included in the contract unit prices paid for other items of work and no additional allowance will be made therefore.

**END OF SECTION**

## SECTION 01 57 23

### STORM WATER POLLUTION PREVENTION PLAN

#### PART 1 GENERAL

##### 1.1 WORK INCLUDES

- A. The Contractor shall furnish and exercise every reasonable precaution to protect channels, storm drains, and bodies of water from pollution and provide all labor, materials, tools, and equipment necessary to prevent storm water pollution associated with construction activities, including preparation of Stormwater Pollution Prevention Plan (SWPPP) and amendments, installation, maintenance and final removal of all temporary and permanent erosion and sediment control measures, in accordance with the requirements of the Contract Documents.
- B. The Contractor shall apply for and obtain coverage under State of California Construction General Permit Order 2009-0009-DWQ as amended per 2010-0014-DWQ and 2012-0006-DWQ (CGP) at least two weeks before starting Work and shall implement storm water pollution prevention measures as prescribed in the approved SWPPP to prevent sediment from entering streams or water bodies throughout the duration of the Work in compliance with the permit requirements. Work shall be performed in accordance with all Federal, State, and local regulations.
1. The Legally Responsible Party (LRP) is the County of Fresno.
  2. The Approved Signatory for the LRP will be a representative designated by the County of Fresno.
  3. Contractor shall coordinate with Engineer and LRP to become a Data Entry Person for the purpose of the Project. This will allow Contractor to upload the required reports and plans to the SMARTS system. Each upload will still require certification by the LRP, and it shall be Contractor's responsibility to notify Engineer and LRP of each SMARTS upload so that LRP can make the necessary approval.
- C. **Penalties:** Failure to comply with this Section may result in significant fines and possible imprisonment. The Regional Water Quality Control Board (RWQCB) or other prosecuting authority may assess fines for each violation. Should the Owner be fined or penalized as a result of the Contractor failing to comply with this Section and applicable permit requirements, the Contractor shall reimburse the Owner for any and all fines, penalties and related costs.
- D. All costs for work required for compliance with this Section shall be included in the price bid for Prepare & Implement SWPPP.

## 1.2 SUBMITTALS

- A. As specified in the General Conditions and Section 01 33 00 – Submittal Procedures.
- B. Submittals under this section shall be completed and submitted at least two weeks prior to beginning work and within 10 days of issuance of the Notice to Proceed. A copy of the SWPPP, Permit Registration Documents, annual reports, and all other permit compliance documents submitted to the State Water Board via the SMARTS system shall be provided to the Engineer for reference and shall be kept onsite in either a job trailer or accessible lockbox.
  - 1. Submit Risk Level calculation and results from the SMARTS web site.
  - 2. SWPPP plan sheets should include, but are not limited to, proposed arrangements and methods for control of erosion, sedimentation, and pollutant conveyance in storm water resulting from demolition and construction activities. Plan sheets shall show that the plans satisfy all Federal and State NPDES permit requirements.
  - 3. Provide sufficient information to permit evaluation of:
    - a. Catch basin protection measures.
    - b. Sheet-flow erosion protection
    - c. Rill, swale and gully erosion protection
    - d. Management of upland flows coming onto the site.
    - e. Surface restoration.
    - f. Post-construction measures
  - 4. Submit narrative describing the means/methods by which the maintenance/inspection procedures will be accomplished. This shall include a schedule for inspection/monitoring of all Storm Water Pollution Prevention BMPs.
  - 5. Submit construction details for all proposed BMPs. All BMPs and details shall be in accordance with Section 1.6 below.
  - 6. Submit all required inspection reports (weekly, quarterly, storm event (pre, during and post), and sampling results) to QSD & LRP within 24 hours of inspection.
- C. Certifications

1. Copy of the Certificate of Training issued by CASQA demonstrating qualification of the designated QSD
2. Copy of the Certificate of Training issued by CASQA demonstrating qualification of the designated QSP(s).

### 1.3 QUALITY ASSURANCE

At minimum, the following measures shall be taken to help ensure control of storm water based pollution. These measures shall not be construed to limit or override the measures set forth and called for in the SWPPP as submitted to the SMARTS system.

- A. Control the rate and effect of dewatering in such a manner as to avoid all objectionable settlement and subsidence and to assure the integrity of the finished work.
- B. Where critical structures or facilities exist immediately adjacent to areas of proposed dewatering, establish reference points and observe at frequent intervals to detect any settlement that may develop. Conduct the dewatering operation in a manner that protects adjacent natural resources and facilities. Cost of repairing all damage to adjacent resources and facilities shall be the sole responsibility of the Contractor.
- C. Before commencing grading, excavation or filling in any part of the site, Contractor shall construct swales, diversion channels, inlet protection barriers, sedimentation traps, and other measures to guide runoff away from the work area and to capture eroded material before it reaches natural water courses. The measures shall be in accordance with the approved storm water pollution prevention plans.
- D. Arrange demolition activities to minimize erosion to the maximum practical extent. Clearing, excavation, and grading shall be limited to those areas of the Project site necessary for demolition. Minimize the area exposed and unprotected.
- E. Clearly mark and delineate the work limits activities. Equipment shall not be allowed to operate outside the limits of work or to disturb existing vegetation. Excavation and grading shall be completed during the dry season to the maximum extent possible.

### 1.4 GENERAL REQUIREMENTS

- A. The Contractor shall exercise care in preserving vegetation and protecting property, to avoid disturbing areas beyond the limits of the Work and promptly repair any damage caused by Contractor operations.
- B. The Contractor shall provide all necessary water pollution control devices to prevent, control, and abate water pollution, and implement good housekeeping pollution control measures to reduce the discharge of pollutants from the Site to the maximum extent practicable. These water pollution control devices include structural BMPs, drains, gutters, slope protection blankets and retention basins

and shall be constructed concurrently with other Work at the earliest practicable time.

- C. Stockpiles of earth and other construction-related materials shall be protected from being transported from the Site by wind or water.
- D. The Contractor shall properly store and handle fuels, oils, solvents, and other toxic materials in a manner not to contaminate the soil or surface waters, enter the groundwater, or be placed where they may enter a live stream, channel, drain, or other water conveyance facilities. All approved toxic storage containers shall be protected from weather. Spills shall be cleaned immediately and cleanup materials shall be properly disposed of. Spills shall not be washed into live streams, channels, drains, storm drains, or other water conveyance facilities.
- E. Excess or waste concrete shall not be washed into the public way or any drainage systems. The concrete wastes shall be retained on-site until they can be appropriately disposed of or recycled. Concrete wastes shall not be washed into live streams, channels, drains, storm drains, or other water conveyance facilities.
- F. Non-stormwater runoff from equipment or vehicle washing and any other activities shall be contained at the work site and properly disposed of. Non-stormwater runoff shall not be allowed to enter live streams, channels, drains, storm drains, or other water conveyance facilities.
- G. The Contractor shall prevent sediments and other materials to be tracked from the Site by vehicle traffic. Construction entrance roadways shall be stabilized to inhibit sediments from being deposited onto public ways. The Contractor shall immediately sweep up accidental depositions and not allow depositions to be washed away by rain or by any other means.

### 1.5 REGULATORY REQUIREMENTS

- A. The Contractor shall comply with the requirements of the State Water Resources Control Board (SWRCB), RWQCB, Owner and any other agencies having jurisdiction in stormwater discharges and non-stormwater waste management.
- B. General Permit Registration Documents:
  - 1. The Contractor shall employ or contract with qualified personnel to prepare all Permit Registration Documents (PRDs), changes of information, annual reporting, Notice of Termination (NOT), and other compliance documents in accordance with the requirements of Article VII of the CGP. The PRDs include the following documents: Notice of Intent (NOI), construction site risk assessment, Site map, SWPPP, annual fee, signed certification statement, and other documents required by the CGP.

2. All engineering calculations, reports, and drawings shall be prepared, sealed and signed by a California licensed engineer in accordance with California Business and Professional Code Section 6700, et seq.
3. The Contractor's qualified personnel shall file the above documents electronically through the State Water Board's Storm Water Multiple Application and Report Tracking System (SMARTS) website.

Contractor shall mail appropriate annual fee to the State Water Board no later than fourteen (14) days prior to the commencement of construction activities and shall pay all annual fees for subsequent years as required by the CGP.

4. The Contractor shall not commence any construction work until a Waste Discharger Identification (WDID) number assigned by the State Water Board is received. The Contractor shall provide the WDID to the Construction Manager, as evidence of the submission of the PRDs.

C. The Contractor shall comply with the following prohibitions and limitations:

1. Discharge prohibitions shall be in accordance with Article III of the CGP.
2. Effluent released from the project site shall meet the requirements of Article V of the CGP.
3. Receiving water limitations shall comply with the requirements of Article VI of the CGP.

#### 1.6 *STORM WATER POLLUTION PREVENTION PLAN DEVELOPMENT AND IMPLEMENTATION*

A. General Requirements:

1. Contractor shall cause to be prepared by a certified QSD, a Storm Water Pollution Prevention Plan implementing the requirements of the CGP for the specified project type and Risk Level.
2. Contractor shall correctly determine the appropriate Risk Level for the project using the Risk Calculator contained within the SMARTS web site. Risk Level is a complex calculation dependent upon site characteristics, site area, project location, type and character of receiving water, and construction schedule, and will not be known with certainty until all necessary data is entered into the SMARTS system.

B. SWPPP Specifications:

1. The SWPPP must be prepared in full conformance with the requirements of Article XIV of the CGP, for the respective project type and Risk Level.



2. The SWPPP must describe the erosion control practices to be implemented during demolition and construction and the selection and implementation of appropriate BMPs to account for site-specific and seasonal conditions. As the SWPPP is considered as a dynamic document, the Contractor shall change and amend the SWPPP as construction conditions and activities warrant.
  3. The SWPPP shall be developed and revised by a QSD retained by the Contractor.
  4. Implementation of all BMPs and all required site monitoring and water testing shall be overseen by a QSP employed or retained by the Contractor.
  5. All erosion and sediment control measures shall be implemented as specified in the SWPPP. Erosion and sediment control may consist of one or more of the following elements, plus other measures as may be appropriate to the specific site:
    - a. Maintenance of existing permanent or temporary storm drainage systems, as necessary.
    - b. Construction of new permanent and temporary storm drainage systems, as necessary.
    - c. Construction of temporary erosion and sediment control facilities, such as silt fences, sediment traps, earth dike/drainage swales and ditches, sandbag barriers, etc.
    - d. Placement and maintenance of topsoil and seeding in areas disturbed by construction and all areas not occupied by structures or pavement in accordance with the requirements of Section 02282 – Erosion Control (Vegetative).
  6. A copy of the SWPPP, including working details (fact sheets) for construction site BMPs and applicable amendments, shall be kept and maintained by the Contractor on the construction site and continuously updated in accordance with CGP requirements to reflect current site conditions throughout the duration of the project.
- C. The Contractor shall implement all activities required by the CGP for the type and Risk Level of the project at hand and as detailed in the SWPPP. The SWPPP shall include, at minimum, the following information.
1. Identification of potential sources of pollution which may be reasonably expected to affect the quality of storm water discharge from the Site.
  2. Calculations supporting the adequacy of selected BMPs to control erosion on the site during the Compliance Storm Event.

3. Description of proposed practices which will be used to reduce the pollutants in storm water discharge from the Site.
  4. Identification and selection of applicable best management practices (BMPs), including BMPs for erosion and sediment control and BMPs for non-stormwater management, material management, and contractor activities.
  5. All stormwater or non-stormwater pollution prevention activities specified in the SWPPP shall comply with the guidance provided in the “*Stormwater Best Management Practice Handbook, Construction*,” November 2009 or more current edition, published by the California Stormwater Quality Association (CASQA), which is available for purchase from the CASQA web site.
  6. Details of the placement of physical BMPs required for installation and the methods used to comply with those BMPs. The Contractor’s preferred techniques shall show how it will comply with the stated objectives of the SWPPP and the terms of the CGP.
  7. A completed copy of the permit, and BMP Inspection Report Template except for the effective date.
  8. BMP inspection reports as required by the CGP.
- D. Non-Stormwater Management: As specified in CGP Attachment C, D or E as appropriate to the project Risk Level, the SWPPP shall discuss any non-stormwater sources (i.e., landscaping irrigation, pipe flushing, street washing and dewatering). In addition, the SWPPP shall include standard observation measures and BMPs, including BCT/BAT practices that are to be implemented in order to reduce the pollutant loading in the discharge waters.
- E. Amendments: All SWPPP amendments shall be prepared by the QSD at no additional cost to the Owner.
1. The Contractor shall, at no additional cost to the Owner, amend the SWPPP whenever there is a change in construction or operations which may affect the discharge of pollutants to stormwater.
  2. The Contractor shall, at no additional cost to the Owner, amend the SWPPP if it is in violation of any conditions of the CGP or has not achieved the general objective of reducing pollutants in stormwater discharges.
- F. Annual Reporting: The Contractor shall submit to the SWRCB via the SMARTS system an annual report, no later than September 1<sup>st</sup> of each year, in accordance with the requirements of Article XVI of the CGP, including but not limited to: a summary and evaluation of all sampling and analysis results, original laboratory reports, chain of custody forms, a summary of all corrective actions taken during

the compliance year and identification of any compliance activities or corrective actions that were not implemented. A project of 90 days or more duration can require more than one Annual Report. See below.

1. An Annual Report is required while the Project is still under construction, if construction begins not later than June 1 of a calendar year and is not completed by September 1 of that same year.
  2. An Annual Report is required, without exception, prior to the September 1 following project completion.
  3. Example: A project commencing on May 31 and completed on September 2 of the same year would require an annual report both by September 1 of the construction year, and by September 1 of the year following.
- G. Notice of Termination: Once construction is completed and the Site has been stabilized with final, sustainable cover, the Contractor shall prepare a Notice of Termination (NOT), including a final site map, photos, and a final project Annual Report, shall obtain necessary signatures from the LRP and shall submit all through the State Water Board's SMARTS website and within 90 days after all land disturbing activities end and construction is complete, in accordance with Article II D of the CGP.

A Notice of Termination is distinct from an Annual Report. Both are required.

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- A. Materials furnished for BMPs shall meet the requirements of the California Stormwater Quality Association, Stormwater Best Management Practice Handbook, Construction – November 2009 edition (or most current version) unless otherwise indicated.
- B. Before the work begins, sufficient equipment shall be available on the site to assure that the operation and adequacy of the erosion control plans can be continuously maintained.

## **PART 3 EXECUTION**

### **3.1 GENERAL DESCRIPTION**

- A. The Contractor shall install and maintain all erosion and sediment control measures and carry out inspection in accordance with the Drawings and the approved SWPPP.

- B. Sediment transport and erosion from working stockpiles shall be controlled and restricted from moving beyond the immediately stockpile area by implementing applicable BMPs, including but not limited to construction of temporary toe-of-slope ditches and accompanying silt fences as necessary. If the BMPs proposed in the SWPPP prove inadequate to control sediment transport and erosion on the Site, the Contractor shall without delay implement additional provisions to obtain effective control. The SWPPP shall be updated to reflect the necessary changes as discussed in paragraph 1.6 above.
- C. The Contractor shall be responsible for taking the proper actions to prevent contaminants and sediments from leaving the project Site. The Contractor shall take immediate action if directed by the Construction Manager, or if the Contractor observes contaminants and/or sediments entering the storm drainage system, to prevent further stormwater from entering the system.

### 3.2 NOTIFICATION AND REPORTING

- A. If non-stormwater pollution occurs in the work area for any reason or when the Contractor becomes aware of any violation of this Section, the Contractor shall correct the problem and shall follow the requirements of the SWPPP for monitoring, control and reporting of non-stormwater discharges.

### 3.3 FIELD QUALITY CONTROL

- A. The Contractor shall maintain the BMPs and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures.

Should the QSP note any deficiencies in necessary BMPs during the course of QSP's inspections and reporting, Contractor shall immediately repair or replace the defective BMPs as required by the QSP.

### 3.4 INSPECTIONS

- A. The Contractor's QSP shall inspect disturbed areas of the construction site, areas that have not been finally stabilized used for storage of materials exposed to precipitation, stabilization practices, structural practices, other controls, and area where vehicles exit the Site at least weekly, and within 48 hours prior to a storm event (with NOAA probability prediction of 50% or greater), every 24 hours during the storm event (during normal business hours) and within 48 hours of the end of any storm that produces 0.5 inches or more rainfall at the site.
- B. The Contractor's QSP shall inspect disturbed areas and areas used for material storage that are exposed to precipitation for evidence of, or the potential for, pollutants entering the drainage system and observe erosion and sediment control measures identified in the SWPPP to ensure that they are operating correctly.

- C. The Contractor's QSP shall inspect discharge locations or points to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Inspect locations where vehicles exit the Site for evidence of offsite sediment tracking.
- D. If required by the Project's Risk Level, Contractor's QSP shall conduct necessary Rain Event Monitoring as required under the CGP.
- E. Inspection Reports: For each inspection conducted, prepare a report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the SWPPP, maintenance performed, and actions taken.

Furnish the report to the Engineer within 24 hours of the inspection as a part of the Contractor's daily report. A copy of the inspection report shall be maintained on Site.

### 3.5 RECORDS

- A. The Contractor shall retain records/copies of data used to complete the PRDs; the SWPPP and all attachments and amendments; compliance certifications; notifications of non-compliance; training; incidents such as spills or other releases, including photographs as available; sampling and analysis of discharges discovered through visual monitoring; all reports required by the CGP; BMP inspections and checklists, and maintenance and repair activities; and activity-based BMPs, such as good housekeeping, that have been implemented.
- B. After the work is complete and finally accepted by the Owner, submit to the Engineer all records/copies of documents required by the CGP, including, but not limited to, the records/copies of the documents noted above and all documents uploaded to the SMARTS system.

### 3.6 MAINTENANCE OF TEMPORARY FACILITIES

- A. Inspect erosion and sediment control structures daily and as specified in the SWPPP.
- B. Sediment shall be removed from behind run off control structures after each storm, or as directed by the Engineer, QSD or QSP.
- C. If areas are seeded, Contractor shall examine those areas during and after major storms to check that grass is becoming established.

### 3.7 DISPOSAL OF SEDIMENT FROM STORM WATER POLLUTION CONTROL STRUCTURES

- A. Sediment excavated from temporary sediment control structures shall be disposed on the site with general fill or with topsoil. Sediment shall be allowed to dry out as required before reuse. All trash shall be removed before reuse.

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- B. Contractor shall place the sediment removed from traps and other structures where it will not enter a storm drain or water course and where it will not immediately reenter the basin.

### 3.8 *REMOVAL OF TEMPORARY STORM WATER POLLUTION CONTROL MEASURES*

- A. In accordance with SWPPP requirements, temporary control measures shall be removed once grading is completed and slopes have stabilized, and permanent drainage works have been constructed. Contractor shall not breach any temporary control structures until the associated catchment area is complete unless approved by the Engineer.

**END OF SECTION**

## **SECTION 01 57 27**

### **DUST CONTROL**

#### **PART 1 GENERAL**

##### *1.1 WORK INCLUDED*

The work of this section consists of implementing measures to prevent air pollution during construction activities, in accordance with Federal, State, and local regulations, and in accordance with the Dust Control Plan (DCP). The DCP can be amended, by the Owner and/or Contractor, as needed should revisions be determined necessary during construction activities. Project disturbance is less than 5 acres. The DCP does not need to be submitted to SJVAPCD, only a Construction Notification at least 48 hours prior to commencing any construction activities.

##### *1.2 RELATED WORK*

- A. Section 01 50 00 – Temporary Facilities
- B. Section 01 51 36 – Watering
- C. DIVISION 31 – Earthwork

##### *1.3 REFERENCES*

- A. San Joaquin Air Pollution Control District (SJVAPCD) Regulation VIII.
- B. Dust Control Plan Fee, Pursuant to the adoption of Rule 3135, Adopted October 20, 2005 and subsequent revisions, compliance assistance bulletins and editions regarding Rule 3135 and PM 10 regulations.

##### *1.4 SUBMITTALS*

- A. As specified in the General Conditions and Section 01 33 00 – Submittal Procedures.
- B. Submit, prior to beginning work and within 15 days of issuance of the Notice to Proceed a DCP.
  - 1. The DCP shall show proposed arrangements and methods for dust control. Show that the plans satisfy all SJVAPCD, State, and Federal Requirements.
  - 2. Provide proof that the revised DCP has been submitted to the SJVAPCD for review and approval.

### 1.5 *QUALITY ASSURANCE*

- A. Control the rate and effect of watering in such a manner as to avoid all objectionable settlement and subsidence as approved by the Engineer and to assure the integrity of the finished work.
- B. Before commencing grading, excavation or filling in any part of the site, Contractor shall construct the required measures specified in the DCP.
- C. Arrange demolition activities to minimize dust to the maximum practical extent. Clearing, excavation, and grading shall be limited to those areas of the Project site necessary for construction. Minimize the area exposed and unprotected.
- D. Clearly mark and delineate the work limits activities. Equipment shall not be allowed to operate outside the limits of work or to disturb existing vegetation.

### 1.6 *REGULATORY REQUIREMENTS*

- A. Contractor shall comply with all provisions of the SJVAPCD regulations, as well as Federal and State regulations.
- B. The requirements of the Dust Control Plan shall apply continuously through the duration of the Contract.

## **PART 2 PRODUCTS**

### 2.1 *EQUIPMENT*

- A. Before the work begins, sufficient equipment and resources shall be available on the site to assure that the operation and adequacy of the dust control measures can be continuously maintained.

### 2.2 *DUST CONTROL MEASURES*

- A. Water shall be available to the contractor for dust control as specified in section 01 50 00 – Temporary Facilities.
- B. Dust Suppressants shall be polymer emulsions or hygroscopic suppressants. Petroleum emulsions and bituminous materials will not be allowed.
  - 1. If dust suppressants other than water are utilized, Contractor shall submit MSDS, Manufacturer's Usage Instructions, and certification by the manufacturer that the product is safe for ground application.
  - 2. If dust suppressants other than water are utilized, contractor shall notify owner 15 days prior to use for notification to the SJVAPCD.
- C. Gravel used for Gravel Pads shall be washed gravel, a minimum of one inch in diameter, and shall be placed a minimum of six inches deep.



## **PART 3 EXECUTION**

### **3.1 GENERAL DESCRIPTION**

- A. Dust control measures shall include, but may not be limited to: Water application, dust suppressant application, physical barriers limiting site access, reduction of vehicle speed on site, utilization of gravel pads, utilization of grizzlies, and wheel washers. If physical barriers are utilized, the Engineer shall approve the location, size, and type. Physical barriers shall be removed upon project completion.
- B. Furnish, install, maintain, and operate necessary control measures and other equipment necessary to prevent dust. Temporary measures shall be to Contractor's own design and Contractor shall be solely responsible for risks related to the management of dust control during construction.

### **3.2 METHODS**

- A. As described in the DCP and approved by the Engineer.

### **3.3 MAINTENANCE OF TEMPORARY FACILITIES**

- A. Inspect dust control facilities daily and as specified in the DCP.
- B. Sediment shall be removed from grizzlies, gravel pads, and/or paved surfaces as required by the DCP, or as directed by the Engineer.
- C. If areas are seeded, contractor shall examine those areas during or after major storms to check that grass is becoming established.

### **3.4 DISPOSAL OF SOIL FROM PAVED SURFACES AND DUST CONTROL DEVICES**

- A. Soil excavated from temporary dust control structures shall be disposed on the site with general fill or with topsoil. Soil shall be allowed to dry out as required before reuse. Any trash shall be removed before reuse.
- B. Contractor shall place the sediment removed from traps and other structures where it will not enter immediately reenter the device or paved area.

### **3.5 REMOVAL OF TEMPORARY DUST CONTROL MEASURES**

- A. Temporary control measures shall be removed once grading is completed and soils have stabilized.

### **3.6 RECORD KEEPING**

- A. Contractor shall keep accurate records as required by the SJVAPCD of dust control methods utilized during the course of construction. The Contractor shall utilize the forms provided by the SJVAPCD, included in the Appendix.

- B. Contractor shall keep a copy of the approved DCP, any approved revisions, and all dust control records at the site.
- C. Contractor shall furnish upon request by the Owner, Engineer, or SJVAPCD Inspector the approved DCP, approved revisions, and dust control records.
- D. Contractor shall maintain dust control records for one year after project completion.

### 3.7 *DUST CONTROL*

- A. The Contractor shall take whatever steps, procedures, or means as are required to limit dust generated by his operations during the Work, including Saturdays, Sundays, and Holidays. Dust shall be controlled to the standards of the local governing agency or, in the absence of local standards, to the satisfaction of the Engineer. Dust control shall extend to any unpaved road which the Contractor or any of his subcontractors are using, to excavation or fill areas, to demolition operations, and to other activities. Control shall be by sprinkling, use of dust palliatives, modification of operations, or any other means acceptable to the local governing agency or, in the absence of same, the Engineer.
- B. If the dust control is not adequate in the opinion of the Engineer, this work may be done by others, and the cost shall be deducted from the total payment due the Contractor.

**END OF SECTION**

## SECTION 01 57 50

### CONSTRUCTION STAKES, LINES, AND GRADES

#### PART 1 GENERAL

##### 1.1 LINES AND GRADE

- A. The Work shall be executed in accordance with the lines and grades indicated in the Contract Documents. Distances and measurements, except elevations and structural dimensions, shall be made on horizontal planes.

##### 1.2 OWNER'S SURVEY SERVICES

- A. Construction surveying and staking for construction will be done by the Engineer or Engineer's representative at the Owner's expense. The Engineer will provide one set of stakes for the following:
1. Horizontal alignment of water mains at 100-foot intervals and at horizontal angle points or change in direction. Water main shall be installed at the minimum depth specified on the Plans. No cut depths will be provided.
  2. Two (2) stakes will be provided for each water facility appurtenances, such as hydrants, blow-offs, air valves, etc.
  3. One (1) set of stakes will be provided for the following at the well and tank sites:
    - a. Layout stakes for proposed facilities, such as concrete slabs, building foundation, hydro-pneumatic tank, and perimeter fencing.
    - b. Grade stakes for site grading.
- B. Additional detail staking layout will be the responsibility of the Contractor.
- C. The Contractor shall be responsible for preserving construction survey stakes, permanent survey monuments and bench marks for the duration of their usefulness. If any construction survey stakes permanent survey monuments or benchmarks are lost or disturbed and need to be replaced, such replacement shall be made by the Engineer at the expense of the Contractor.
- D. The Contractor shall notify the Engineer at least three (3) working days before he will require survey services in connection with laying out of any portion of the Work. The Contractor at his own expense shall dig all holes necessary for line and grade stakes prior to requesting survey services that depend on such digging.

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**END OF SECTION**

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**SECTION 01 77 00**  
**CONTRACT CLOSEOUT**

**PART 1 GENERAL**

**1.1 GENERAL**

- A. It is the intent of these Contract Documents that the Contractor shall deliver a complete and operable facility capable of performing its intended functions and ready for use.

**1.2 CLEANING**

- A. Throughout the period of construction the Contractor shall keep the Work site free and clean of all rubbish and debris, and shall promptly remove from the site, or from property adjacent to the site of the Work, all unused and rejected materials, surplus earth, concrete, plaster, and debris, excepting select material which may be required for refilling or grading.

**1.3 FINAL SITE CLEAN-UP**

- A. Upon completion of the Work, and prior to final acceptance, the Contractor shall remove from the vicinity of the Work all paint, surplus material, and equipment belonging to him or used under his direction during construction.
- B. The Contractor shall restore to original condition all property not designated for alteration by these Contract Documents.

**1.4 FINAL BUILDING CLEAN-UP**

- A. On all building projects and wherever else applicable, besides general broom cleaning, the following special cleaning shall be performed at completion of the Work:
  - 1. Putty stains and paint shall be removed from glass; glass shall be washed and polished, inside and outside. Care shall be exercised so as not to scratch glass.
  - 2. Marks, stains, fingerprints, and other soil and dirt shall be removed from painted, decorated, or stained work.
  - 3. Waxed woodwork shall be cleaned and polished.
  - 4. Hardware shall be cleaned and polished of all traces; this shall include removal of stains, dust, dirt, paints, and blemishes.
  - 5. Spots, soil, paint, plaster, and concrete shall be removed from tile; tile work shall be washed afterwards.

6. Fixtures and equipment shall be cleaned and stains, paint, dirt, and dust shall be removed.
7. Temporary floor protection shall be removed; floors shall be cleaned, waxed, and buffed.
8. Dust, cobwebs, and traces of insects and dirt shall be removed.

#### 1.5 WASTE DISPOSAL

- A. The Contractor shall dispose of surplus materials, waste products, demolition materials, and debris. The Contractor shall transport and dispose of waste materials in accordance with applicable laws and regulations.

#### 1.6 PROJECT RECORD DOCUMENTS

- A. The Contractor shall maintain at the site, available to the Owner and Engineer, one copy of the Contract Documents, Drawings, Shop Drawings, Change Orders, and other modifications in good order and annotated to show all changes made during construction. These Documents shall be delivered to the Engineer for the Owner upon completion of the Work.
- B. Record documents shall be reviewed during progress meetings to ascertain that all changes have been recorded.
- C. Store Record Documents separate from documents used for construction.

#### 1.7 TOUCH-UP AND REPAIR

- A. The Contractor shall touch-up or repair finished surfaces on structures, equipment, fixtures, or installations that have been damaged prior to final acceptance. Surfaces on which such touch-up or repair cannot be successfully accomplished shall be completely refinished or in the case of hardware and similar small items, the item shall be replaced. Such items shall include, but not be limited to, the following:
  1. Road surfaces
  2. Exposed structure surfaces
  3. Exposed equipment surfaces
  4. Exposed piping surfaces

#### 1.8 EQUIPMENT START-UP

- A. After all acceptance tests have been completed by the Contractor and Owner but prior to final acceptance, the Contractor shall recheck all equipment for proper alignment and adjustment, check oil levels, re-lubricate all bearings and wearing

points, and in general assure that all equipment is in proper condition for continuous operation.

**1.9 OPERATION AND MAINTENANCE (O&M) MANUALS**

- A. See Section 01 33 00 for Operation and Maintenance Manuals.

**1.10 FINAL EQUIPMENT CHECK**

- A. After testing and before acceptance, all equipment shall be test run by the Owner for a minimum of 7 days to ensure proper operation. At the end of the test run each piece of machinery shall be lubricated and all components and couplings checked for proper alignment and adjustment.
- B. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's inspection.
- C. Provide submittals to the Owner required by other governing authorities.

**1.11 MANUFACTURER'S CERTIFICATES OF PROPER INSTALLATION**

1. The Contractor shall submit manufacturers' certificates of proper installation for all items of equipment.

**PART 2 PRODUCTS**

(Not Used)

**PART 3 EXECUTION**

(Not Used)

**END OF SECTION**

## SECTION 02 01 20

### PROTECTION OF UNDERGROUND FACILITIES AND SURVEY MONUMENTS

#### PART 1 GENERAL

##### 1.1 UNDERGROUND FACILITIES

- A. Shown or Indicated: The information and data shown or indicated in the Contract Documents with respect to existing underground facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such underground facilities, including Owner, or by others.
1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data; and
  2. The cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
    - a. Reviewing and checking all such information and data,
    - b. Locating all Underground Facilities shown or indicated in the Contract Documents,
    - c. Coordination of the Work with the owners of such underground facilities, including Owner, during construction, and
    - d. The safety and protection of all such underground facilities and repairing any damage thereto resulting from the Work.
- B. Not Shown or Indicated: If an underground facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated with reasonable accuracy in the Contract Documents, the following shall apply.
1. Contractor shall develop and execute a work-plan, subject to Engineer's approval to protect underground facilities.
  2. The Contractor shall expose, prior to staking and trenching, all existing utilities and existing facilities which may control proposed facility grades, and alignment. Two working days notice shall be given to the Engineer prior to commencing this work.
  3. Full compensation for all costs involved in locating, verifying, protecting, exposing, and otherwise providing for utilities shall be included in the amounts bid for the various items of work, and no separate payment shall be made therefore.



## 1.2 PROTECTION

- A. The Contractor shall not interrupt the service function or disturb the supporting base of any Utility by disrupting any facility identified in the Plans and Specifications without authority from the Owner or order from the Engineer. Where protection of such facilities is required to ensure support of utilities, the Contractor shall, unless otherwise provided, furnish and place the necessary protection at the Contractor's expense.
- B. The Contractor shall be prepared at all times with labor, equipment and materials to make repair on damaged mains or Utility facilities. The Contractor shall immediately notify the Engineer and the Utility owner if he disturbs, disconnects or damages any Utility. The Contractor shall bear the costs of repair or replacement of any Utility facility described with reasonable accuracy in the Plans and Specifications that is damaged by the Contractor. No extra compensation will be made for the repair of any services or mains damaged by the Contractor, nor for any damage incurred if the neglect or failure of providing protective barriers, lights and other devices or means required to protect such existing utilities or facilities described with reasonable accuracy in the Plans and Specifications.

## 1.3 SURVEY MARKERS AND PERMANENT REFERENCE POINTS

### A. Surveying and Permanent Survey Markers

The Engineer will take measurements to assure the preservation of survey markers (monuments and bench marks). The Contractor shall not disturb permanent survey markers without the consent of Engineer and shall bear the expense of replacing any that may be disturbed without permission.

1. Replacement of survey markers shall be done only by the Engineer.
2. If disturbing of markers cannot be avoided, the Owner shall pay the cost of replacing said markers.

### B. Lot Corner Monuments

The Contractor shall preserve property line and corner survey markers except where their destruction is unavoidable and the Contractor is proceeding in accordance with accepted practice. Markers that are lost or disturbed by his operations shall be replaced at the Contractor's expense by the Engineer.

## END OF SECTION

## **SECTION 02 41 00**

### **DEMOLITION**

#### **PART 1 GENERAL**

##### *1.1 DESCRIPTION*

- A. The work of this section consists of demolition and removal of pavements, slabs, miscellaneous debris, signs, barriers, salvaged items, structures, pumps, tanks, piping, electrical equipment, and portions of abandoned utilities.
- B. This work may also include milling of asphaltic concrete and all operations associated with crushing of Portland cement concrete for aggregate base.
- C. Definitions:
  - 1. Portland Cement Concrete: A mixture of Portland cement, fine aggregate, coarse aggregate, admixtures (if used) and water, proportioned and mixed. Also, included is rebar.
  - 2. Asphalt Concrete: A mixture of liquid asphalt and graded aggregate used as paving material for roadways and parking lots.

##### *1.2 WORK INCLUDED*

- A. Repair and restoration of areas damaged due to demolition work.
- B. Salvaging of equipment for Owner.
- C. Removal of demolished materials from site.
- D. Remove existing piping and other existing structures as shown on the Plans to be removed.
- E. Properly dispose of all removed materials.
- F. Dewatering as needed in order to complete the proposed demolition.
- G. Removal of trees and landscaping as required for construction.

##### *1.3 RELATED WORK*

- A. Section 03 33 00 – Cast-In-Place Concrete
- B. Section 03 33 01 – Cast-In-Place Concrete (Site Work)

- C. Section 31 11 00 – Clearing and Grubbing
- D. Section 31 23 00 – Earthwork

#### 1.4 SEQUENCING

- A. The project includes switching both CSA 30 and CSA 32 from surface water to groundwater. The Contractor shall sequence work to minimize interference with water treatment facilities operation. The distribution system shall remain operational at all times. Water shut off is limited to a 4 hrs maximum. Contractor shall inform the Owner of the schedule shut off at least 48 hrs in advance. The water plant must remain in operation until the new system has been approved for use. Prior to that time, work will be limited to mobilization, limited demolition, and exploratory digging to the extent that the plant can remain in operation.
- B. The new system, pump/ manganese treatment shall be operational and tested for a minimum of 3 days or until Division of Drinking approves the system to be connected to the distribution system. The water produced during commissioning period shall be sent to the storm drain installed as part of the project.

#### 1.5 REGULATORY REQUIREMENTS

- A. Obtain any required permits.
- B. Dispose of removed materials in an approved disposal or salvage facility.

#### 1.6 REFERENCES

- A. Section 16 – Clearing and Grubbing, State Standard Specifications
- B. Section 19 – Earthwork, State Standard Specifications

#### 1.7 SUBMITTALS

- A. Submittals shall be in accordance with the General Provisions
- B. As specified in Section 01 33 00 – Submittal Procedures
- C. Demolition plan including sequence of operations. The plan shall specifically address methods of demolition, schedule, sequence of demolition, and procedures for archeological monitoring. Demolition shall not proceed until the plan has been approved.

#### 1.8 QUALITY ASSURANCE

- A. General: Take all necessary precautions with regard to safety in carrying out the demolition and site work. Erect suitable barriers around open excavations and fulfill all appropriate requirements of CAL/OSHA. Comply with safety requirements for demolition, ANSI A10.6-90.

### 1.9 PROJECT CONDITIONS

- A. Underground utilities exist at this site. Contractor shall take all necessary precautions to protect said utilities. Notify Engineer of any deviation in utility location from that which is shown on the drawings.
- B. Keep dust to a minimum at removal site and on haul roads. Use sprinklers or water trucks as necessary or as directed by the Engineer.
- C. Ensure safety of persons in demolition area. Provide temporary barricades as required.
- D. Excavations may encounter groundwater and require dewatering depending on the time of year and amount of seasonal run-off. Loose sands exposed in excavation sidewalls may be unstable and require shoring or lying back in accordance with OSHA requirements. Flowing sands may also be encountered in excavations below groundwater levels.

### 1.10 CLOSEOUT SUBMITTALS

- A. Show all capped and abandoned utility terminations and location of remaining facilities on project Record Drawings.

## PART 2 PRODUCTS

### 2.1 REPAIR AND RESTORATION MATERIALS

- A. Concrete shall be as specified in Section 03 33 01 – Cast-In-Place Concrete.
- B. Backfill materials shall be as required by Section 19 – Earthwork, State Standard Specifications.
- C. Asphalt and concrete shall be replaced in conformance with governing authority standards.

### 2.2 MATERIALS

- A. Salvaged Materials: Materials to be salvaged shall remain the property of the Owner and shall be stockpiled as directed by the Engineer. Contractor shall inventory all salvaged materials. Stockpiled materials shall be free of hazardous substances. Salvage materials as specified on the plans.
- B. Items to be Salvaged and Relocated shall be salvaged and/or relocated as shown on the drawings, or as directed by the Engineer.
- C. Materials and items demolished and not designated for reuse, salvage or transfer to the Owner, as well as all debris, rubbish and other materials resulting from the demolition operations, shall become the property of the Contractor and shall be removed from the site within 48 hours of demolition.

- D. Storage or sale of the removed items will not be permitted at the site.

### **PART 3 EXECUTION**

#### **3.1 INSPECTION**

- A. Prior to demolition, inspect the site conditions, verifying all governing dimensions, notes and specification. Notify the Engineer of any errors or omissions in the contract documents.
- B. Make such explorations and probes as are necessary to ascertain any required protection measures before proceeding with the demolition and removal work.

#### **3.2 PREPARATION**

- A. Protect existing, appurtenances, structures, which are not to be demolished.
- B. Prior to demolition work, all soil erosion control measures specified in Section 01 57 23 - Stormwater Pollution Prevention Plan (SWPPP) and inlet protection barriers shall be in place. Contractor shall provide appropriate measures to prohibit demolition debris and/or soil from entering any watercourse.
  - 1. Protect all buildings, structures, utilities, and vegetation to remain.

#### **3.3 DEMOLITION REQUIREMENTS**

- A. Conduct demolition to protect and minimize damage to structures and existing improvements.
- B. Conduct salvaging to protect and minimize damage to salvaged equipment.
- C. Execute the work in a careful, orderly and safe manner, with the least possible disturbance to the public. Cease operations immediately if adjacent work appears to be endangered. Do not resume operations until corrective measures have been taken.
- D. Pavement and Slabs:
  - 1. Remove completely all Portland cement concrete slabs-on-grade including, but not limited to, equipment pads, sidewalks, etc. If approved by the Engineer, the Contractor may crush Portland concrete for use as aggregate base.
  - 2. Saw cut existing asphalt concrete pavements cleanly in straight continuous lines. Remove asphalt concrete pavement as shown on the drawings. The Contractor may utilize the recycled asphalt concrete pavement for use as base course on this project. The Engineer shall determine if milling may be used in lieu of sawcutting under this contract.

- a. Asphalt Concrete Milling Equipment: Milling machines shall be power operated, self-propelled machines capable of removing the desired thickness. They shall have sufficient power, traction and stability to accurately maintain depth of cut and slope.
3. Any material thus processed shall conform to the specifications for Section 32 11 23 – Aggregate Base
  4. In areas that are demolished, but where no future roads or structures are shown, the exposed subgrade shall be scarified an additional 18 inches before placing backfill.
- E. Concrete and Masonry Structures: Remove structure to a minimum of 3 feet below grade. Break remaining portions to permit drainage. Remove completely if under proposed structures or roadways.
- F. Items to be Salvaged: Remove as directed by the Engineer. Remove carefully. All salvaged material remains the property of the Owner. Store where directed by the Engineer.
- G. Abandoned Utilities: Remove above ground utilities and terminate as approved by the utility company and the Engineer. Remove necessary portions of underground utilities to within 24 inches of excavation or final grade. Plug abandoned pipes and conduits with concrete plugs. Plugs shall be 6 inches or 2 times the pipe diameter in length, whichever is greater.
1. Water lines shall be capped as close as possible to active mains.

### 3.4 SALVAGE EQUIPMENT

- A. Salvaged equipment shall be delivered to the Owner at a designated site within the project site. Salvaged equipment shall be placed on wood or concrete blocks, so the equipment will be 4 inches minimum above ground elevation.

### 3.5 ORDER OF WORK

- A. Existing facilities shall remain in operation until the new well, tank and booster pump system is in operation. Coordination will be required with the Owner for temporary shut-off of existing pipeline system for connection of new pipeline to existing pipelines and new chlorination connection. Contractor shall submit plans to Owner for approval for shut-off duration at least 10 days prior to shut-off.
1. Hours and duration of shut-off will be limited to a maximum of 4 hours in any single day.

### 3.6 *PRESERVATION*

- A. If indicated or required, preserve trees, plants, or other features designated to remain. Protect trees and plants from damage; fell trees in a manner which shall not injure standing trees, plants and improvements which are to be preserved.

### 3.7 *RESTORATION*

- A. All demolition areas, staging/stockpiling, and open excavations shall be filled in accordance with the Earthwork Sections. Fill all open excavations deeper than one foot to an elevation to match the surrounding topography.
  - 1. New Construction Areas: As shown on drawings.

### 3.8 *DISPOSAL*

- A. As specified in Section 01 50 00 – Temporary Facilities.

**END OF SECTION**

## SECTION 03 15 00

### CONCRETE ACCESSORIES

#### PART 1 GENERAL

##### 1.1 WORK INCLUDED

- A. Furnish all materials, supplies, and performing all labor to furnish and install concrete accessories as described in this section of the Specifications, shown on the Plans. The work shall include, but is not necessarily limited to

##### 1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
1. D412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
  2. D570 - Standard Test Method for Water Absorption of Plastics
  3. D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
  4. D638 - Standard Test Method for Tensile Properties of Plastics
  5. D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
  6. D747 - Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam
  7. D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
  8. D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
  9. D2240 - Standard Test Method for Rubber Property—Durometer Hardness
- B. U. S. Army Corps of Engineers (USACE):
1. CRD-C-572, Specification for Polyvinyl Chloride Waterstop.

##### 1.3 RELATED WORK

- A. Section 03 30 00 – Cast-in-Place Concrete



#### 1.4 SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions and Section 01 33 00 – Submittal Procedures.
- B. Product Data:
  - 1. Waterstops and Preformed Expansion Joint Material: Sufficient information on each type of material for review to determine conformance of material to requirements specified.
- C. Samples: Provide samples of each product to be supplied under this section.
- D. Manufacturer's Installation Instructions: For all materials specified under this section
- E. Quality Control Submittals:
  - 1. Certificates of Compliance:
    - a. Written certificates that waterstops and Preformed Expansion Joint Material supplied meet or exceed physical property requirements of this section.

#### 1.5 QUALITY ASSURANCE

- A. Mock-Ups:
  - 1. Welding Demonstration:
    - a. Demonstrate ability to weld acceptable joints in polyvinyl chloride waterstop before installation of waterstop begins.
- B. Field Joints:
  - 1. Polyvinyl Chloride Waterstop Field Joints: Shall be free of misalignment, bubbles, inadequate bond, porosity, cracks, offsets and other defects which would reduce the potential resistance of the material to water pressure at any point. Replace defective joints, remove faulty material from the site.
- C. Inspections:
  - 1. Quality of welded joints will be subject to acceptance of the Engineer.
  - 2. Polyvinyl Chloride Waterstop: The following defects that represent a partial list that will be grounds for rejection.
    - a. Any combination of offset or crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16-inch or 15 percent of the material thickness, at any point, whichever is less.

- b. Misalignment of the joint, which will result in misalignment of the waterstop in excess of 1/2-inch in 10 feet.
- c. Porosity in the welded joint as evidenced by visual inspection.
- d. Bubbles or inadequate bonding.

**PART 2 PRODUCTS**

**2.1 MANUFACTURED UNITS**

**A. Waterstops:**

**1. Polyvinyl Chloride Waterstops:**

- a. One of the following or Engineer approved equivalent:
  - 1) Vinylex Corporation, Kwik-Tie.
  - 2) Greenstreak Plastic Products Company, Inc.
- b. Type: Ribbed Waterstop. Unless otherwise specified, joints shall be constructed as follows:
  - 1) Construction Joints: ribbed type, width to be 6 inches unless otherwise specified or shown on the plans, without center bulb.
  - 2) Expansion Joints: ribbed type, width to be 6 inches unless otherwise specified or shown on the plans, with hollow center bulb.
- c. Provide polyvinyl chloride waterstops complying with following requirements:

<b>Property</b>	<b>Test Method</b>	<b>Required Limits</b>
Water absorption	ASTM D 570	0.15% max
Tear Resistance	ASTM D 624	200 lb/in (35 kN/m) min.
Ultimate Elongation	ASTM D 638	350% min.
Tensile Strength	ASTM D 638	2000 psi (13.78 Mpa) min.
Low Temperature Brittleness	ASTM D 746	No Failure @ -35° F (-37° C)
Stiffness in Flexure	ASTM D 747	600 psi (4.13 Mpa) min.
Specific Gravity	ASTM D 792	1.45 max.
Hardness, Shore A	ASTM D 2240	79 $\pm$ 3
Tensile Strength after accelerated extraction	CRD-C 572	1850 psi (11.03 Mpa) min.
Elongation after accelerated extraction	CRD-C 572	300% min.
Effect of Alkalies after 7 days: Weight Change	CRD-C 572	between -0.10% / +0.25%

Hardness Change		+/- 5 points
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2. Hydrophilic waterstop
  - a. One of the following or Engineer approved equivalent:
    - 1) W. R. Grace and Company, Adcor ES
    - 2) Greenstreak Plastic Products Company, Inc., Hydrotite
  - b. Performance Requirements as follows:

**Chloroprene Rubber**

Property	Test Method	Required Limits
Tensile Strength	ASTM D 412	1300 PSI min.
Ultimate Elongation	ASTM D 412	400% min.
Hardness (Shore A)	ASTM D 2240	50 +/- 5
Tear Resistance	ASTM D 624	100 lb/inch min.

**Modified Chloroprene (Hydrophilic) Rubber**

Property	Test Method	Required Limits
Tensile Strength	ASTM D 412	350 PSI min.
Ultimate Elongation	ASTM D 412	600% min.
Hardness (Shore A)	ASTM D 2240	52 +/- 5
Tear Resistance	ASTM D 624	50 lb/inch
Expansion Ratio	Volumetric Change - Distilled Water @ 70° F	3 to 1 min.

3. Bentonite Strip Waterstop
  - a. One of the following or Engineer approved equivalent:
    - 1) Cetco, Waterstop, RX.
    - 2) Green Streak, Swell Stop
- B. Preformed Expansion Joint Materials:
  1. Preformed Synthetic Sponge Rubber Expansion Joint Material:
    - a. Manufacturers: One of the following or Engineer approved equivalent:
      - 1) JD Russell Co, Reflex
      - 2) W.R. Meadows, Sponge Rubber Expansion Joint
  2. Preformed Bituminous Fiber Expansion Joint Material:
    - a. Conform to ASTM D994, preformed bituminous type, 1/2-inch thick

b. Manufacturers: One of the following or Engineer approved equivalent:

- 1) JD Russell Co., Fiberflex
- 2) W.R. Meadows, Fiber Expansion Joint

## 2.2 ACCESSORIES

A. Adhesives and sealants:

1. Provide as recommended by product supplier.

## PART 3 EXECUTION

### 3.1 INSTALLATION

A. Waterstops - General:

1. Waterstops shall be stored so as to permit free circulation of air around the waterstop material and to prevent direct exposure to sunlight.
2. Install waterstops in concrete joints where indicated on the Drawings.
3. Carry waterstops in walls into lower slabs and join to waterstops in slabs with appropriate types of fittings.
4. In Water bearing Structures: Provide all joints with waterstops, whether indicated on the Drawings or not.
5. Provide waterstops that are continuous.
6. Set waterstops accurately to position and line as indicated on the Drawings.
7. Hold and securely fix edges in position at intervals of not more than 24-inches so that they do not move during placing of concrete.
8. Position the waterstop so that the center axis of the waterstop shall be coincident with the centerline of the joint, unless detailed otherwise.
9. Do not drive nails, screws, or other fasteners through waterstops in vicinity of construction joints.
10. Secure waterstop against movement at not more than 24-inches on centers.
11. Terminate waterstops 3-inches from top of finish surfaces of walls and slabs unless otherwise specified or indicated on the Drawings.
12. When any waterstop is installed in the concrete on one side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than two days, suitable precautions shall be taken to

shade and protect the exposed waterstop from direct rays of sunlight during the entire exposure and until the exposed portion is embedded in concrete.

13. Use specific type in applications as indicated on the Drawings.
14. No scrap or recycled material shall be used.

B. Polyvinyl Chloride Waterstops:

1. Install waterstops so that joints are watertight.
2. Weld joints such as unions, crosses, ells, and tees, with thermostatically controlled equipment recommended by waterstop manufacturer.
  - a. The material shall not be damaged by heat sealing.
  - b. Make joints by overlapping then simultaneously cut the ends of the sections to be spliced so they will form a smooth even joint.
  - c. The continuity of the waterstop ribs and tubular center axis shall be maintained.
  - d. The splices shall have a tensile strength of not less than 60 percent of the unspliced materials tensile strength.
3. Butt joints of the ends of two identical waterstop sections may be made while the material is in the forms.
4. All joints with waterstops involving more than two ends to be joined together, and all joints that involve an angle cut, alignment change, or the joining of two dissimilar waterstop sections shall be prefabricated prior to placement in the forms, providing not less than 24-inch long strips of waterstop material beyond the joint.
5. Vertical crosses and tees shall be prefabricated by the manufacturer. Horizontal crosses or tees may be field or factory welded.
6. Split type waterstop will not be permitted except where specifically indicated on the Plans.

C. Hydrophillic Waterstops

1. Apply adhesive recommended by the manufacturer for the given application.
2. Cut coil ends square or at proper angle for mitered corners with a sharp blade to fit splices together without overlaps.
3. Splices and exposed cells shall be sealed using adhesives recommended by the manufacturer.

4. Provide minimum concrete cover per manufacturer's recommendations and in no instance less than 2 inches.
5. Surfaces shall be even, smooth, clean and dry.
6. Do not use when the head exceeds 150'

D. Bentonite Waterstops

1. Apply adhesive recommended by the manufacturer for the given application.
2. Maintain the minimum clear cover recommended by the manufacturer but in no instance less than 2 inches.
3. Butt splice by pressing ends together to ensure no separation or air pockets. Do not overlap the ends of the waterstops.
4. Remove release paper immediately prior to the second concrete pour.
5. Replace waterstop showing signs of premature swelling, discontinuity or debris contamination.

E. Preformed Expansion Joint Material:

1. Fasten expansion joint strips to concrete, masonry, or forms with adhesive. No nailing will be permitted, nor shall expansion joint strips be placed without fastening.
2. Install expansion joint filler in accordance with manufacturer's instructions.
3. Install joint filler ½ inch (13 mm) below the concrete surface.
4. Prior to sealing, slide expansion joint cap over the expansion joint.
5. Place concrete and screed to finish grade, allow adequate curing time before removing top of expansion joint cap. Pull cap free and discard.
6. Seal with joint sealant.

F. Joints:

1. Install construction and expansion joints as indicated on the Plans.

**END OF SECTION**

## SECTION 03 15 12

### POST INSTALLED CONCRETE ANCHORS

#### PART 1 GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section includes the following types of post installed anchors:
  - 1. Wedge anchors.
  - 2. Adhesive anchors.
- B. Related Sections:
  - 1. Division 03 Section "Cast-in-Place Concrete."
  - 2. Division 05 Section "Metal Fabrications."

##### 1.3 REFERENCES

- A. ACI:
  - 1. ACI 318 – Building Code Requirements for Structural Concrete
  - 2. ACI 355.2 – Standard for Evaluating the Performance of Post-Installed Mechanical Anchors in Concrete
- B. ASTM:
  - 1. ASTM A36 – Standard Specification for Carbon Structural Steel
  - 2. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
  - 3. ASTM A193 – Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
  - 4. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

5. ASTM A615 – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
  6. ASTM B633 – Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
  7. ASTM B695 – Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
  8. ASTM C881 – Standard Specification Epoxy-Resin-Based Bonding Systems for Concrete
  9. ASTM E488 – Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
  10. ASTM E1512 – Standard Test Methods for Testing Bond Performance of Bonded Anchors
  11. ASTM F593 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- C. Federal Specifications A-A-1922A, A-A01923A and A-A-55614 for Expansion and Shield-Type Anchors
- D. ICC-ES
1. ICC-ES AC70 – Acceptance Criteria for Fasteners Power-Driven into Concrete, Steel and Masonry Elements
  2. ICC-ES AC106 – Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Concrete or Masonry Elements
  3. ICC-ES AC193 – Acceptance Criteria for Mechanical Anchors in Concrete Elements
  4. ICC-ES AC308 – Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated; include manufacturer's written installation instructions, physical characteristics, and load tables.
- B. Evaluation Reports: From ICC-ES for each type of post installed anchor indicated.



### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed post-installed anchor installations similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of not less than 3 years of successful in-service performance.
- B. Source Limitations for Post Installed anchors: Obtain post-installed anchors from a single source from single manufacturer.
- C. ICC Evaluation Service Approval: Use only products that have current ICC Evaluation Service approval.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to job site in manufacturer's or distributor's packaging undamaged, complete with installation instructions.
- B. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration.

## PART 2 PRODUCTS

### 1.2 MATERIALS

- A. Bolts and Studs: ASTM A307; ASTM A449 where "high strength" is indicated on the Drawings.
- B. Carbon and Alloy Steel Nuts: ASTM A563.
- C. Carbon Steel Washers: ASTM F436.
- D. Carbon Steel Threaded Rod: ASTM A36; or ASTM A193 Grade B7; or ISO 898 Class 5.8.
- E. Wedge Anchors: ASTM A510; or ASTM A108.
- F. Stainless Steel Bolts, Hex Cap Screws, and Studs: ASTM F593.
- G. Stainless Steel Nuts: ASTM F594.
- H. Zinc Plating: ASTM B633.
- I. Hot-Dip Galvanizing: ASTM A153.

### 1.3 POST INSTALLED ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Post Installed Concrete Anchors  
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1. Hilti Corporation.
  2. Simpson Strong-Tie Company.
- B. Postinstalled Anchors, General: Provide post-installed anchors as indicated on Drawings and herein specified.
1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in solid grouted unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.
  3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts (Type 304), ASTM F 593, and nuts, ASTM F 594.
- C. Wedge Anchors: Wedge type, torque-controlled, with impact section to prevent thread damage complete with required nuts and washers. Provide anchors with length identification markings conforming to ICC ES AC01 or ICC ES AC193. Type and size as indicated on Drawings.
1. Subject to compliance with requirements, provide one of the following:
    - a. Hilti Kwik Bolt 3, ICC ESR-1385.
    - b. Hilti Kwik Bolt TZ, ICC ESR-2302 (carbon steel and AISI Type 304 Stainless Steel).
    - c. Simpson Strong-Tie, Strong-Bolt wedge anchor, ICC-ES-ESR-1771.
- D. Adhesive Anchors: Two component, all weather, high performance epoxy complying with descriptive requirements of ASTM C 881, Type IV, Grade 3, Classes A, B, and C, except for gel time; mixed and dispensed through motionless, static mixing nozzle and dispensing tool. Threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, adhesive injection system, and manufacturer's installation instructions. Type and size as indicated on Drawings.
1. Subject to compliance with requirements, provide one of the following:
    - a. Hilti HAS threaded rods with HIT RE 500 v3 Adhesive Anchoring System for anchorage to concrete, ICC ESR-3814.
    - b. Simpson Strong-Tie; SET-XP Anchoring Adhesive, ICC ESR-2508.

## **PART 3 EXECUTION**

### **1.4 EXAMINATION**

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **1.5 INSTALLATION**

- A. General: Install anchors in accordance with manufacturer's written installation instructions and as indicated on Drawings.
- B. Drilling Concrete and Concrete Unit Masonry:
  - 1. Drill holes with rotary impact hammer drills using carbide-tipped bits and core drills using diamond core bits. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.
    - a. Cored Holes: Where anchors are to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer.
    - b. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.
    - c. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
- C. Wedge Anchors, Sleeve Anchors, and Undercut Anchors: Protect threads from damage during anchor installation. Sleeve anchors shall be installed with sleeve fully engaged in part to be fastened. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10% of the specified torque, 100% of the specified torque shall be reached within 7 or fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor shall be removed and replaced unless otherwise directed by the Architect.
- D. Cartridge Injection Adhesive Anchors: Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing

Post Installed Concrete Anchors

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toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

- E. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.

#### 1.6 *FIELD QUALITY CONTROL*

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Testing: 10% of each type and size of drilled-in anchor shall be proof loaded by the independent testing laboratory. Adhesive anchors and capsule anchors shall not be torque tested unless otherwise directed by the Engineer. If any of the tested anchors fail to achieve the specified torque or proof load within the limits as defined on the Drawings, all anchors of the same diameter and type as the failed anchor shall be tested, unless otherwise instructed by the Engineer.
  - 1. Torque shall be applied with a calibrated torque wrench.
  - 2. Proof loads shall be applied with a calibrated hydraulic ram. Displacement of adhesive and capsule anchors at proof load shall not exceed  $D/10$ , where  $D$  is the nominal anchor diameter.
- C. Minimum anchor embedments, proof loads and torques shall be as shown on the Drawings.

END OF SECTION

## SECTION 03 15 20

### ANCHOR BOLTS AND POST-INSTALLED ANCHORS

#### PART 1 GENERAL

##### 1.1 WORK INCLUDED

- A. The work of this section consists of furnishing and installing all materials and equipment and providing all labor necessary to complete the work shown on the drawings and/or listed below and all other work and miscellaneous items not specifically mentioned but reasonably inferred for a complete installation, including all accessories and appurtenances required for a completed system.
- B. Cast-in-Place anchor bolts, anchor bolts and threaded rod anchors for epoxy grouting.
- C. Expansion anchors to be installed in hardened concrete.

##### 1.2 RELATED WORK

- A. Section 03 30 00 – Cast In Place Concrete
- B. Section 03 60 00 - Grout
- C. Section 05 50 00 – Fabricated Metal
- D. Section 05 12 00 – Structural Steel Framing

##### 1.3 SUBMITTALS

- A. As specified in Section 01 30 00 – Submittal Procedures.

##### 1.4 GENERAL

- A. Unless otherwise specified or indicated on the drawings, all anchor bolts shall be cast-in-place bolts, shall have a diameter of at least 3/4 inch, and shall be headed and shall include a square washer a minimum of 1/4 inch thick and 2 inches square.
- B. Expansion anchors and threaded rod anchors indicated or accepted in lieu of cast-in-place anchor bolts for equipment or structural framing shall have a diameter of at least 3/4 inch and shall be ICBO Evaluation Report listed.
  - 1. Unless otherwise specified or indicated on the drawings, or approved by the Engineer, all other expansion anchors shall have a diameter of at least 1/2 inch.

**PART 2 MATERIALS**

**2.1 MATERIALS**

- A. Nuts and washers for anchor bolts and expansion anchors shall be the same material as the bolts or anchors they are used with.

<b>Application</b>	<b>Reference</b>
A. Anchor Bolts and Nuts	
1. Carbon Steel	ASTM A307
2. Stainless Steel	IFI-104, Grade 304 or 316
3. Galvanized Steel	Carbon steel bolts and nuts; hot-dip galvanized, ASTM A153 and A385.
B. Threaded Rod Anchors and Nuts	
1. Carbon Steel	ASTM A307 or A36
2. Stainless Steel	IFI-104, Grade 304 or 316
3. Galvanized Steel	Carbon steel bolts and nuts; hot-dip galvanized, ASTM A153 and A385
C. Flat Washers	ANSI B18.22.1; of the same material as anchor bolts and nuts.
D. Expansion Anchors	
1. For Concrete	Fed Spec FF-S-325; wedge type, Group II, Type 4, Class 1 or 2; self-drilling type, Group III, Type 1; or nondrilling type, Group VIII, Type 1 or 2; Hilti ICBO #3987 or 4627, ITW Ramset/Red Head ICBO #2391, Rawl Bolt ICBO #4514, or ICBO approved equivalent.

- B. Anchor bolts and threaded rod anchors for buried service and in splash zones shall be stainless steel. Anchor bolts, threaded rod anchors, and expansion anchors for immersion service shall be stainless steel. Expansion anchors for buried service and in splash zones shall be stainless steel. All other anchor bolts, threaded rod anchors, and expansion anchors shall be galvanized steel unless otherwise specified or indicated on the Plans.

**PART 3 EXECUTION**

**3.1 ANCHOR BOLTS**

- A. Anchor bolts shall be delivered in time to permit setting before the structural concrete is placed. Anchor bolts which are cast in place in concrete shall be provided with sufficient threads to permit a nut to be installed on the concrete side of the concrete form or supporting template.
- B. Anchor bolts and threaded rod anchors which are to be epoxy grouted shall be clean and free of coatings that would weaken the bond with epoxy.

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- C. Two nuts, a jam nut, and a washer shall be furnished for anchor bolts and threaded rod anchors indicated on the drawings to have locknuts; two nuts and a washer shall be furnished for all other anchor bolts.
- D. Anti-seize thread lubricant shall be liberally applied to projecting, threaded portions of stainless steel anchor bolts and threaded rod anchors immediately before final installation and tightening of the nuts.

### 3.2 *EXPANSION ANCHORS*

- A. Expansion anchors shall be installed in conformity with the manufacturer's instructions and ICBO Evaluation Report recommendations for maximum holding power, but in no case shall the depth of hold be less than four (4) bolt-hole diameters. The minimum distance between the center of any expansion anchor and an edge or exterior corner of concrete shall be at least four and one half (4-1/2) times the diameter of the hole in which the anchor is installed. Unless otherwise indicated on the Plans, the minimum distance between the centers of the expansion anchors shall be at least eight (8) times the diameter of the hole in which the anchors are installed.
- B. Anti-seize thread lubricant shall be liberally applied to threaded stainless steel components immediately before assembly.

**END OF SECTION**

## SECTION 03 30 00

### CAST-IN-PLACE CONCRETE

#### PART 1 GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
  - 1. Mat slabs
- B. Related Sections:
  - 1. Division 07 Section “Underslab Vapor Barrier.”
  - 2. Division 22 and 23 Sections as applicable to Plumbing and Mechanical items embedded in concrete.

##### 1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
  - 1. Mill certificates: Steel producer's certificates of mill analysis, tensile, and bend tests for reinforcing steel. Submit certificates accompanying the Shop Drawings.
- D. Construction Joint Layout: Show locations of proposed construction and control joints other than, or in addition to, those as indicated on the drawings. Location of joints is subject to approval of the Architect.
- E. Material Certificates: For each of the following, signed by manufacturers:

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Westside Groundwater Project  
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1. Cementitious materials.
  2. Admixtures.
  3. Form materials and form-release agents.
  4. Steel reinforcement and accessories.
  5. Curing compounds.
  6. Floor and slab treatments.
  7. Bonding agents.
  8. Adhesives.
  9. Semirigid joint filler.
  10. Joint-filler strips.
  11. Repair materials.
- F. Material Test Reports: For aggregates, from a qualified testing agency, indicating compliance with requirements:
- G. Mill certificates: Steel producer's certificates of mill analysis, tensile, and bend tests for reinforcing steel. Submit certificates accompanying the Shop Drawings.
- H. Steel Reinforcement Record Drawings: Shop drawings shall be corrected to reflect actual field changes and shall be submitted to the Architect.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel who shall be thoroughly familiar with the specified requirements, completely trained and experienced in the necessary skills required for work performed under this Section. In actual installation of the work of this Section, use adequate numbers of skilled workmen to insure installation in strict accordance with the contract documents design.
- B. Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- C. Testing Agency: An independent agency retained by the Owner, acceptable to the Architect, and qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
  2. ACI 318-08, "Building Code Requirements for Structural Concrete" with amendments per 2010 California Building Code, Chapter 19, Section 1908.

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## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
  - 1. Identification: Bundle and tag reinforcing steel with grades and suitable identification marks for checking, sorting and placing. Use waterproof tags and markings and do not remove until steel is in place.

## 1.6 COORDINATION

- A. Slab Finishes: Coordinate slab finish requirements with trades installing or applying floor finishes or treatments over slabs. Finishes shall include but not be limited to concrete sealing, topical concrete vapor control barrier, ceramic tile, resinous/fluid applied floor systems, adhered resilient floor systems, and adhered carpet.

## PART 2 - PRODUCTS

### 2.1 FORM MATERIALS

- A. Earth Forms: Use for sides of footings only where soil is firm and stable and concrete will not be exposed. Where earth forms are used, cut excavations neat and accurate to size for placing concrete directly against the excavation.
- B. Rough-Formed Finished Concrete: Use for formed concrete that will not be exposed in the finished work, fabricate forms of plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Smooth-Formed Finished Concrete: Use for formed concrete that will be exposed in the finished work, fabricate forms of form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  - 1. Plywood, metal, or other approved panel materials.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

### 2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

- D. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
  - 1. Slabs on Grade and Foundations: Use precast concrete blocks, plastic-coated steel with bearing plates or specifically designed wire-fabric supports fabricated of plastic. Precast blocks shall be not less than 3 inches by 3 inches square and shall have a compressive strength equal to or greater than the strength of the surrounding concrete.
  - 2. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
- F. Fabricating Reinforcement: Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice" or ACI SP-66 and the details shown on the Drawings.
  - 1. In the case of fabricating errors, do not rebend or straighten reinforcement in a manner that will damage or weaken the material.
  - 2. Bends shall be made cold using pin sizes as recommended ACI 318 as modified by T24, CCR, Part 2.
  - 3. Unacceptable Work: Reinforcement with any of the following defects will not be permitted:
    - a. Bar lengths, depths, and bends exceeding specified fabrication tolerance.
    - b. Bends or kinks not indicated on the project Drawings or the final Shop Drawings.
    - c. Bars with reduced cross-section due to excessive rusting or other cause.

## 2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C 150, Type II, gray.
    - a. ASTM C 150, Type V where concrete will be in contact with corrosive soils or mixed with aggregates containing reactive substances. Low alkali cement shall contain not more than 0.6 percent total alkali when calculated as sodium oxide as determined by the method given in ASTM C114.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.
  - 1. Where concrete expansion from alkali silica or alkali carbonate reactions is anticipated, provide aggregate with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
  - 2. Fine and coarse aggregates shall be regarded as separate ingredients. Each size of coarse aggregate, as well as the combination of sizes when two or more are used, shall conform to the grading requirements of ASTM C33.
  - 3. Coarse aggregate: Coarse aggregate shall consist of a clean, hard, fine grained, sound crushed rock, or washed gravel or a combination of both. It shall be free from oil, organic

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matter, or other deleterious substances. Aggregate shall be uniformly graded from one-quarter inch size to maximum size.

4. The maximum size of aggregates used in the project shall be consistent with the dimensions and form of the section being placed, the location and spacing of the reinforcing bars, and with the method of compaction, and shall be such as will produce dense and uniform concrete free from rock pockets, honey-comb and other irregularities. The nominal maximum size of the aggregate shall not be more than one-fifth the narrowest dimension between forms, one-third the depth of slabs nor three-fourths the minimum clear spacing between reinforcing bars.
5. Combined Grading: The combined grading shall be such that the percentage by weight of the combined aggregates shall fall within the limits established as follows:

Sieve number or size in inches (maximum)	Percentage by Weight		
	1-1/2"	1"	3/4"
Passing a 2 inch	---	---	---
Passing a 1-1/2 inch	95-100	---	---
Passing a 1 inch	70-90	90-100	---
Passing a 3/4 inch	50-80	70-95	90-100
Passing a 3/8 inch	40-60	45-70	55-75
Passing a No. 4	35-55	35-55	40-60
Passing a No. 8	25-40	27-45	30-46
Passing a No. 16	16-34	20-38	23-40
Passing a No. 30	12-25	12-27	13-28
Passing a No. 50	2-12	5-15	5-15
Passing a No. 100	0-3	0-5	0-5

6. Special grading or size limitations: When reviewed and approved by the Architect, other gradings or maximum size limitations may be used if mixes are designed and tested in accordance with Concrete Mixture Design Method C specified in "Concrete Mixtures" Article.
7. Soundness of Aggregates: Both the coarse and fine aggregate shall be tested by the use of a solution of sodium or magnesium sulfate, or both, whenever in the judgment of the Architect, such tests are necessary to determine the quality of the material. Such tests shall be performed in accordance with ASTM C88 and the results shall show compliance with the limits set forth in ASTM C33.
8. Reactivity: Aggregates shall be free from any substance which may be deleteriously reactive with the alkalis in the cement in an amount sufficient to cause excessive expansion of the concrete or which will interfere with normal hydration of the cement. Acceptability of the aggregate shall be based upon satisfactory evidence that the aggregate is free from such materials.
9. Aggregates shall be tested, when required by the Architect prior to the concrete mix being established, in accordance with the following specifications:

Test	Specification
Abrasion	ASTM C131 and C535
Gradation	ASTM C136
Alkali Reactivity	ASTM C289 and C227
Organic Impurities	ASTM C40
Clay Lumps	ASTM C142

10. Maximum Coarse-Aggregate Size: Nominal size as indicated on Drawings.
11. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

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- C. Water: ASTM C 94/C 94M and potable.

## 2.4 ADMIXTURES

- A. Admixtures shall be reviewed and approved by the Structural Engineer.
- B. Calcium chloride, thiocyanates or admixtures containing more than 0.05% chloride ions are not permitted.
- C. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Certification of requirements and chloride ion content is required from the admixture manufacturer prior to mix design review.
1. Air-entraining Admixture: ASTM C260.
    - a. Available Products: Subject to compliance with requirements, provide one of the following products:
      - 1) Euclid Chemical Company (The); Air Mix.
      - 2) BASF/Master Builders, Inc.; Micro-Air.
      - 3) Sika Corporation; Sika AER.
  2. Water-reducing Admixtures: ASTM C494 Type A.
    - a. Available Products: Subject to compliance with requirements, provide one of the following products:
      - 1) Euclid Chemical Company (The); Eucon WR-75.
      - 2) BASF/Master Builders Inc.; Pozzoloth 220N.
      - 3) Sika Corporation; Plastocrete 161.
  3. Water-reducing, Retarding Admixtures: ASTM C494 Type D.
    - a. Available Products: Subject to compliance with requirements, provide one of the following products:
      - 1) Euclid Chemical Company (The); Eucon Retarder-75.
      - 2) BASF/Master Builders Inc.; Pozzoloth 300 R.
      - 3) Sika Corporation; Plastiment.
  4. High Range Water-Reducing Admixture (HRWR): ASTM C494 type F or G.
    - a. Available Products: Subject to compliance with requirements, provide one of the following products:
      - 1) Euclid Chemical Company (The); Eucon 37.
      - 2) BASF/Master Builders Inc.; Rheobuild 1000.
      - 3) Sika Corporation; Sikament 300.
    - b. When more than 30 minutes is required between the addition of admixtures to final placement of the concrete, a combination of water-reducing, set controlling admixtures (ASTM C494, Types A, D and E) may be used.
  5. Non-Corrosive, Non-Chloride Accelerator: ASTM C494 Type C or E.
    - a. Available Products: Subject to compliance with requirements, provide one of the following products:
      - 1) Euclid Chemical Company (The); Accelguard 80.
      - 2) BASF/Master Builders Inc.; Pozzutec 20+.
      - 3) Sika Corporation, Plastocrete 161FL.
    - b. The admixture manufacturer shall have long-term (more than one year duration) non-corrosive test data on metal deck and reinforcing steel from an independent

testing laboratory using an acceptable accelerated corrosion test method such as using electrical potential measures.

## 2.5 CURING AND SEALING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Construction Chemicals - Building Systems; Confilm.
    - b. ChemMasters; SprayFilm.
    - c. Conspec by Dayton Superior; Aquafilm.
    - d. Dayton Superior Corporation; Sure Film (J-74).
    - e. Edoco by Dayton Superior; BurkeFilm.
    - f. Euclid Chemical Company (The), an RPM company; Eucobar.
    - g. Lambert Corporation; LAMBCO Skin.
    - h. L&M Construction Chemicals, Inc.; E-CON.
    - i. Meadows, W. R., Inc.; EVAPRE.
    - j. Sika Corporation; SikaFilm.
    - k. Symons by Dayton Superior; Finishing Aid.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, clear or white polyethylene film, 6 mil minimum thickness, or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Construction Chemicals - Building Systems; Kure 1315.
    - b. ChemMasters; Polyseal WB.
    - c. Conspec by Dayton Superior; Sealcure 1315 WB.
    - d. Edoco by Dayton Superior; Cureseal 1315 WB.
    - e. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
    - f. Meadows, W. R., Inc.; Vocomp-30.
    - g. Symons by Dayton Superior; Cure & Seal 31 Percent E.
  2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.6 VAPOR RETARDERS

- A. Sheet Vapor Retarder: As specified in Division 07 Section "Underslab Vapor Retarder," ASTM E 1745, Class A, 15 mil thickness minimum.

## 2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

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- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.

## 2.8 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
  - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

## 2.9 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301, ACI 318, Chapter 4, and Chapter 19 of the California Building Code.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
    - a. The testing agency used for preparing mixture designs shall be different from the testing agency retained by the Owner for testing concrete strength and materials.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  - 1. Fly Ash: Not to exceed 15 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to the following percentages by weight of cement.
  - 1. Reinforced concrete exposed to chloride in service: 0.15 percent.
  - 2. Reinforced concrete that will be dry or protected from moisture in service: 1.00 percent.
  - 3. Other reinforced concrete: 0.30 percent.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in concrete with a water-cementitious materials ratio below 0.50.

## 2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Proportion normal-weight concrete mixture as indicated on Drawings for strength, slump, water/cement ratio, and maximum aggregate size.

## 2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
  1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Project site mixing of structural concrete will not be permitted. Project site mixing of concrete for other purposes may be permitted only when reviewed and approved by the Architect. When allowed, measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ACI 318. Mix concrete materials in appropriate drum-type batch machine mixer, the capacity of the mixer shall be such that it will handle one or more full sack batches.
- C. Control of Admixtures:
  1. Admixtures shall be charged into the mixer as solutions and shall be measured by means of an approved mechanical dispensing device. The liquid shall be considered a part of the mixing water. Admixtures that cannot be added in solution may be weighed or may be measured by volume if so recommended by the manufacturer.
  2. If two or more admixtures are used in the concrete, they shall be added separately to avoid possible interaction that might interfere with the efficiency of either admixture or adversely affect the concrete.
  3. Addition of retarding admixtures shall be completed within 1 minute after addition of water to the cement has been completed, or prior to the beginning of the last three-quarters of the required mixing, whichever occurs first.
  4. Admixtures shall be used in accordance with the manufacturer's instructions.
- D. Concrete shall be mixed only in quantities for immediate use. Concrete which has set shall not be retempered, but shall be discarded.
- E. When concrete arrives at the project with slump below that suitable for placing, as indicated by the specifications, water may be added only if neither the maximum permissible water-cement ratio nor the maximum slump is exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required. An addition of water shall be accompanied by a quantity of cement sufficient to maintain the proper water-cement ratio. Such addition shall be reviewed by the Architect.



## PART 3 - EXECUTION

### 3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
  - 1. Where earth is used for forming sides of footings, increase the width of footings by 1 inch on each side of the footing.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
  - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
  - 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 1. Install keyways, recesses, and the like, for easy removal.
  - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- B. Conduits and Pipes Embedded in Concrete:
  - 1. Pipes, other than conduits for electrical circuits, shall not be embedded in structural concrete unless specifically reviewed and approved by the Architect. Any pipe or conduit may pass through any walls or floor slab by means of a sleeve so located that it does not impair the strength of the structure. Openings larger than 12 inches in any dimension shall be as detailed on the structural plans.
  - 2. Unless otherwise approved, embedded pipes or conduits, other than those merely passing through, shall be not larger in outside dimension than one-third the thickness of the slab, wall, or beam in which they are embedded, nor shall they be spaced closer than three diameters or widths on center and shall have at least 1-1/2 inches concrete cover.
  - 3. Sleeves, pipes, or conduits of aluminum shall not be embedded in structural concrete unless effectively coated or covered to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.

### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete must be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.4 VAPOR RETARDERS

- A. Vapor retarders shall be installed in accordance with the requirements of Division 07 Section "Underslab Vapor Retarder."

### 3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  - 1. Coordinate installation of steel reinforcement with installation of vapor barrier specified in Division 07 Section "Below Grade Vapor Retarder."

2. Do not cut or puncture vapor retarder; if cut or damaged, vapor barrier shall be repaired in accordance with Division 07 Section "Below Grade Vapor Retarder."
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

### 3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
  2. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
  1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
  1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
  2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
  3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

### 3.7 CONVEYING

- A. Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients and in a manner which will assure that the required quality of the concrete is maintained.

- B. Conveying equipment shall be of a size and design such that detectable setting of concrete shall not occur before adjacent concrete is placed. Conveying equipment shall be cleaned at the end of each operation or work day. Conveying equipment and operations shall conform to the following additional requirements:
  - 1. Truck mixers, agitators and non-agitating units and their manner of operation shall conform to the applicable requirements of ASTM C94.
  - 2. Belt conveyors shall be horizontal or at a slope which will not cause excessive segregation or loss of ingredients. Concrete shall be protected against undue drying or rise in temperature. A suitable device shall be used at the discharge end to prevent apparent segregation. Mortar shall not be allowed to adhere to the return length of the belt. Long runs shall be discharged into a hopper or through a baffle.
- C. Chutes shall be metal or metal-lined and shall have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20 feet long and chutes not meeting the slope requirements may be used provided they discharge into a hopper before distribution.
- D. Pumping or pneumatic conveying equipment shall be of suitable kind with adequate pumping capacity. Pneumatic placement shall be controlled so that segregation is not apparent in the discharged concrete. The loss of slump in pumping or pneumatic conveying equipment shall not exceed 2 inches. Concrete shall not be conveyed through pipe made of aluminum or aluminum alloy. When the concrete is placed into final position by means of pumping, the pumping method for placing concrete shall be reviewed and approved by the Structural Engineer at least one week prior to placing the concrete.

### 3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
  - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- D. Deposit and consolidate concrete for slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  2. Maintain reinforcement in position on chairs during concrete placement.
  3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  4. Slope surfaces uniformly to drains where required.
  5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- F. Hot-Weather Placement: Comply with ACI 305 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

### 3.9 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not permanently exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces permanently exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Slab Finish Types: Slab finish types, flatness, and levelness tolerances shall be as indicated below. Where slabs are indicated to be sloped, slope shall be as indicated on the Drawings. Finished slabs shall have a slope not greater than 1/4 inch per one foot unless otherwise indicated on the Drawings.
  - 1. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
    - a. Slab surface shall be flat and level within 1/4 inch in 2 feet as determined by using a 2 foot straightedge placed anywhere on the slab in any direction.
  - 2. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing.
    - a. Slab surface shall be flat and level within 1/4 inch in 10 feet as determined by using a 10 foot straightedge placed anywhere on the slab in any direction.
  - 3. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
    - a. Slab surface shall be flat and level to within 1/8 inch in 10 feet as determined by using a 10 foot straightedge placed anywhere on the slab in any direction.

### 3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

### 3.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing

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operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture Curing: This method shall not be used on floor slabs receiving adhered floor systems, fluid applied floor systems, or sealers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    - a. Use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    - b. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
  - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
    - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
  - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### 3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
  - 1. Defer joint filling as long as possible and until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

### 3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Owner. Remove and replace concrete that cannot be repaired and patched to Owner's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
    - a. Limit cut depth to 3/4 inch.
    - b. Make edges of cuts perpendicular to concrete surface.
    - c. Perimeters of cut areas shall be square or rectangular in shape with cuts vertical and horizontal.
    - d. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried.
    - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
  - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  - 2. After concrete has cured at least 14 days, correct high areas by grinding.
  - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
  - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.



6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Owner's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

### 3.15 FIELD QUALITY CONTROL

- A. Testing and Inspecting Agency: Owner will engage and pay for a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
1. Testing Agency shall be acceptable to the Owner, Architect and the Building Official.
- B. Contractor Responsibilities:
1. Schedule tests and inspections with the Testing Agency sufficiently in advance of operations to allow for the assignment of testing personnel and for the completion of testing and inspecting responsibilities.
  2. Provide access to the work for the Testing Agency.
  3. Furnish any necessary labor to assist the designated testing agency in obtaining and handling samples at the project or other sources of materials.
  4. Provide and maintain for the sole use of the testing agency adequate facilities for safe storage and proper curing of concrete test specimens on the project site for the first 24 hr. as required by ASTM C31.
- C. Testing and Inspections:
1. Testing shall be performed by the designated Testing and Inspection Agency.
  2. Inspections shall be performed by the Testing and Inspection Agency.
  3. Testing and inspections shall be in accordance with the 2010 California Building Code, Section 1704.4 and Table 1704.4, and shall include but not be limited to the following:
    - a. Inspection of steel reinforcement.
    - b. Inspection of headed bolts and studs prior and during concrete placement.
    - c. Verification of use of required design mixture.
    - d. Sampling of concrete for strength tests, slump, air content, and temperature of concrete at time of placement.
    - e. Inspection of concrete placement, including conveying and depositing.
    - f. Inspection of curing procedures and maintenance of curing temperature.

- g. Verification of concrete strength before removal of shores and forms from beams and slabs.
      - h. Inspection of formwork.
- D. Sampling and Testing of Steel Reinforcement:
  - 1. Samples of reinforcing steel shall be taken by a designated approved testing agency at place of distribution prior to shipment or at project site.
  - 2. Where samples are taken from bundles as delivered from the mill, with the bundles identified as to heat number and provided the mill analyses accompany the report, one tensile test and one bend test shall be made from a specimen from each 10 tons or fraction thereof of each size of reinforcing steel.
    - a. Where positive identification of the heat number cannot be made or where random samples are to be taken, one series of tests shall be made from each 2-1/2 tons or fraction thereof of each size of reinforcing steel.
  - 3. Each sample shall consist of no fewer than two pieces, each 18 inches long, of each size and grade or reinforcing steel.
- E. Batch Plant Inspection: The quality and quantity of materials used in transit mixed concrete and in batched aggregates shall be continuously inspected at the location where materials are measured by an approved Testing and Inspection Agency.
  - 1. Waiver of Batch Plant Inspection: Batch plant inspection will not be required under the following conditions:
    - a. The concrete plant complies fully with the requirements of ASTM C94, Sections 8 and 9, and has a current certificate from the National Ready Mixed Concrete Association. The certification shall indicate that the plant has automatic batching and recording capabilities.
    - b. The Testing Agency shall check the first batching at the start of work and furnish mix proportions to the licensed weighmaster.
    - c. Licensed weighmaster shall positively identify materials as to quantity and certify to each load by a ticket.
    - d. Tickets shall be transmitted to the Contractor by cement truck driver with load identified thereon. Do not accept loads without a load ticket identifying the mix; Contractor shall keep a daily record of placements identifying each truck, its load and time of receipt, and approximate location of deposit in the structure and will transmit a copy of the daily record to the Architect.
    - e. At the end of the project, the weighmaster shall furnish an affidavit to the Architect certifying that all concrete furnished conforms in every particular to proportions established by mix designs.
    - f. The Testing Agency shall certify and submit evidence of compliance to the governing agency and obtain governing agency's approval prior for a waiver of batch plant inspection prior to mixing the concrete.
- F. Placement Record: A record shall be kept on-site of the time and date of placing the concrete in each portion of the structure. Such record shall be kept until the completion of the structure and shall be open to the inspection of the governing agency.
- G. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
  - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture but not less than one sample for each 50 cu. yd. or fraction thereof and one sample for each 2,000 square feet of slab area.

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- a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M.
  - a. Cast and laboratory cure four standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at 7 days for information and two cured specimens at 28 days for strength acceptance, the fourth specimen shall be held in reserve in case additional testing is necessary.
  - a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
8. Test results shall be reported in writing to Owner, Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7 and 28-day tests.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Owner. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
11. Additional testing and inspecting will be performed to determine compliance of replaced or additional work with specified requirements.
  - a. The cost of additional testing of replaced work will be paid for by the Owner with the amount being deducted from the Contract Amount by a Change Order.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION

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## SECTION 03 30 01

### CAST-IN-PLACE CONCRETE (SITE WORK)

#### PART 1 GENERAL

##### 1.1 WORK INCLUDED

- A. Work required under this section consists of furnishing all materials, supplies, equipment, tools, transportation, and facilities, and performing all labor and services incidental to furnishing and installing concrete work as described in this section of the Specifications, shown on the accompanying Plans, or reasonably implied therefrom, except as hereinafter specifically excluded. The work shall include, but is not necessarily limited to:
1. All form work including special forms as required for any special construction and/or to accommodate the work of others and removal of forms.
  2. All concrete reinforcement, placement, bending and forming thereof.
  3. All concrete and cement finishing, all surface treatment and curing including non-slip finishes.
  4. Installation of all reglets, bolts, anchors, cans, sleeves, column bolts, etc., whether furnished under this section or by others.
  5. The furnishing of all items required to be or shown on the Plans as embedded in concrete, which are not specifically required under other sections.
  6. Setting headers and screens finishing, curing, and protecting concrete.
- B. Where prior inspection and test of materials are required, documentary evidence, in the form of test reports, shall be furnished prior to the time the material is incorporated into the work. All rejected material shall be promptly removed from the premises.

##### 1.2 RELATED WORK

- A. Division 3 – Concrete
- B. Division 31 – Earthwork
- C. Division 32 – Exterior Improvements
- D. Division 33 – Utilities
- E. Section 05 5 00 – Metal Fabrications

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- F. Section 05 05 20 – Bolts, Washers, Anchors and Eyebolts
- G. Section 09 90 00 – Painting and Coating

### 1.3 REFERENCES

- A. American Concrete Institute (ACI)
- B. American Society for Testing and Materials (ASTM)
- C. State Standard Specifications
- D. California Building Code (CBC)

### 1.4 DEFECTIVE WORK

- A. Work considered to be defective may be ordered, by the Engineer, to be replaced in which case the Contractor shall remove and replace the defective work at his expense. Work considered to be defective shall include, but not be limited to, the following:
  - 1. Concrete incorrectly formed, or not conforming to details and dimensions on the Plans or with the intent of these documents, or concrete the surfaces of which are out of plumb or level.
  - 2. Concrete in which defective or inadequate reinforcing steel has been placed.
  - 3. Concrete containing wood, cloth, or other foreign matter, rock pockets, voids, honeycombs, cracks or cold joints not scheduled or indicated on the Plans.
  - 4. Concrete below specified strength.

### 1.5 SUBMITTALS

- A. As specified in Section 01 33 00 – Submittal Procedures
- B. Provide material certificates, shop fabrication and placement drawings, and schedule for all reinforcing steel, embedded items, form release and curing compounds.
- C. The Contractor shall provide a proposed concrete placement plan (to minimize the effects of cracking and differential settlement) to the Engineer, and gain approval of said plan, prior to ordering of reinforcing steel. As a minimum this plan shall contain the layout of horizontal and vertical construction joints, spaced no greater than 50 feet apart (unless specifically approved otherwise by the Engineer), and a pour schedule for the individual slab and wall pours. All construction joints shall be sized in conformance with the Typical Longitudinal Keys Detail and shall contain water stops as shown on the Construction Joint With Waterstop Detail.

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## **PART 2 PRODUCTS**

### **2.1 CONCRETE**

1. Concrete shall conform to Section 90 of the State Standard Specifications. Unless otherwise shown or specified, all concrete shall contain not less than 611 pounds of Portland cement per cubic yard of concrete (6-1/2 sack) with a minimum 28-day compressive strength of 4500 psi. Portland cement shall be Type II
  2. Concrete shall contain 6%  $\pm$ 1% entrained air.
  3. Water/cement ratio shall not exceed 0.45 (by weight).
  4. Slump at placement shall be 4 inches.
- B. Concrete used for thrust blocks or for pipe encasement shall contain not less than 517 pounds of Type II Portland Cement per cubic yard of concrete (5 1/2 sack).
- C. Slurry cement backfill used in lieu of compacted soil shall contain not less than 188-pounds of Type II Portland Cement per cubic yard of concrete (2 sack) and shall comply with Section 19-3.02E of the State Standard Specifications.

### **2.2 AGGREGATE**

- A. Aggregate for normal weight concrete shall conform to Section 90-1.02C, "Aggregates" of the State Standard Specifications. Aggregates shall be free of dirt, clay balls, roots, bark and other deleterious substances and shall be thoroughly washed before use.
- B. The combined aggregates for concrete shall conform to the grading limits for the one inch, maximum size specified in Section 90-1.02C(4)(d), "Aggregate Gradation" of the State Standard Specifications, Combined Aggregate Gradings.

### **2.3 WATER**

- A. Water shall comply with Section 90-1.02D, "Water" of the State Standard Specifications, and shall be clean and free from injurious amounts of acids, alkalis, salts, oils, organic materials or other deleterious substances.

### **2.4 FLYASH**

- A. Fly Ash: Shall comply with SSS Section 90-1.02B(3), "Supplementary Cementitious Materials", and shall comply with AASHTO M 295, Class F or N.
1. Type of fly ash shall be compatible with the type of cement and the intended use of the concrete.

- B. The combined weight of fly ash conforming to AASHTO M 295, Class F or N shall not exceed the amount provided for in Section 90-1.02B(3), “Supplementary Cementitious Materials” of the State Standard Specifications.

## 2.5 *ADMIXTURES*

Admixtures shall comply with Section 90-1.02E, “Admixtures”, of the State Standard Specifications

- A. Air Entraining: ASTM C260
- B. Water Reducing: ASTM C494, Type A, D or F
- C. Accelerating: ASTM C494, Type C or E
  - 1. No admixture containing any chloride ions is acceptable.
- D. Retarding: ASTM C494, Type B, D or G

## 2.6 *REINFORCING STEEL*

- A. Rebar shall be ASTM designation A615, Grade 60.
- B. Welded wire fabric shall conform to ASTM A 1064.

## 2.7 *EXPOSED-TO-VIEW CONCRETE*

- A. For exposed-to-view concrete, where legs of metal supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class I).
- B. Metal bar supports in slab covers for sewage-containing structures shall also be provided with plastic coated legs.

## 2.8 *FORM MATERIALS*

- A. Exposed Concrete: Plywood complying with U.S. Plywood Standard PS-1 “BB (Concrete Form) Plywood” Class I, or better.
- B. Textured Finish Concrete: Units of face design, size arrangement and configuration to match control sample.
- C. Cylindrical Columns and Supports: Metal, fiberglass or waxed paper tubes of sufficient wall thickness to resist imposed loads without deformation.
- D. Form Release Agent shall leave behind a paintable concrete surface.
  - 1. Release #1, The Burke Co., or Engineer approved equivalent.

## 2.9 CURING MATERIALS

- A. Polyethylene film
- B. Reinforced waterproof paper
  - 1. Sisal Kraft, Orange Label, or approved equal.
- C. Liquid-membrane curing compound
  - 1. Curing compound shall comply with ASTM C309, Type 2.
    - a. White pigmented material
    - b. Clear pigment may be used for concrete that will be exposed to public view.

## 2.10 WATERSTOP

- A. Comply with the provisions of Section 03 15 00 – Concrete Accessories.

## PART 3 EXECUTION

### 3.1 REINFORCING STEEL

- A. Comply with CRSI, “Placing Reinforcing Bars” and as specified herein.
- B. Place reinforcing steel and embedded items in accordance with approved shop drawings.
- C. Splicing of bars shall be by lapping. Lapped splices shall be 45 bar diameters for bar size through #8 and 60 bar diameters for larger bars, unless otherwise shown on the Plans.
- D. Splicing of the wire fabric shall be by lapping. Lapped splices shall be two full mesh, minimum.
- E. All rebar in vertical walls shall be supported by concrete block spacers or metal chairs.
- F. Prior to placement of the concrete, reinforcing steel shall be cleaned and free of all concrete, dirt, oil, mill scale, rust or other coatings that would reduce or destroy the bond.
- G. All reinforcing steel and embedded items shall be reviewed and approved by the Engineer prior to concrete placement.



### 3.2 FORMS

- A. All forms shall be cleaned and an approved agent applied each time they are used and shall be so constructed and set as to resist, without springing or settlement, the pressure of the concrete and the placing operations.
- B. In designing forms and falsework, the concrete shall be treated as a liquid weighing at least 150 lbs. per cubic foot for vertical loads and not less than 85 lbs. per cubic foot for horizontal pressure. The design of the forms and falsework system shall include allowances for temporary construction loads. The rate of placement of concrete shall be so regulated that the pressures caused by the wet concrete will not exceed the designed form pressure. The unsupported length of wooden columns and compression members shall not exceed 30 times the width of the least side.
- C. All forms shall be set and maintained in true alignment, grade and section until the concrete has sufficiently set. The interior surfaces of forms shall be adequately treated with an acceptable material to insure non-adhesion of mortar. All forms shall be mortar-tight. When forms appear to be unsatisfactory in any way, concrete placement shall be stopped until the defects have been corrected.
- D. All exposed outside corners, including the top edges of all walls, machinery bases and curbs shall have a  $\frac{3}{4}$ -inch chamfer.
- E. Metal tie rods or anchorages within the forms shall be fitted with suitable cones or comparable devices. Metal tie rods or anchorages shall be removed to a depth of 1" from the surface without injury to the concrete. All fittings for metal ties shall be of such design that upon their removal, the cavities which are left will be of the smallest possible size, but of sufficient diameter to allow the cavity to be "dry packed" with cement mortar. The cavities shall be filled with cement mortar and the surface left sound, smooth and even.
- F. Form release agent shall be applied to the form so that no agent comes in contact with reinforcing steel.

### 3.3 PLACING

- A. All concrete shall be placed before it has taken its initial set and shall be placed in horizontal layers and in such a manner as to avoid segregation. The concrete adjacent to the forms and joints shall be thoroughly internal consolidated with a vibrator operating at not less than 4,500 vibrations per minute.
  - 1. Pumping equipment shall be of suitable type, without Y-sections, and with adequate pumping capacity.
  - 2. Loss of slump in pumping shall not exceed  $1\frac{1}{2}$ ".
  - 3. Concrete shall not be placed through reinforcing that may cause separation of aggregates.

- B. The concrete shall be deposited as nearly as possible in its final position. Drop chutes and elephant trunks shall be used on drops greater than 5 feet. Concrete shall be placed at such a rate that all concrete in the same lift will be deposited on plastic concrete. The concrete comprising each unit of work shall be placed in a continuous lift.
- C. The Contractor shall notify the Engineer 24 hours (1 working day) prior to concrete placement.
1. The form work and reinforcing steel placement shall be approved by the Engineer prior to ordering concrete.
- D. Form Removal. Minimum times for removal after concrete placement are as follows:
- |   |         |
|---|---------|
| Beam sides but not shoring                | 3 days  |
| Column forms and wall forms               | 2 days  |
| Forms for supported slabs but not shoring | 14 days |
- E. Construction Joints
1. At ends of the first concrete pour, provide forms that positively locate any waterstop. Ensure the end forms of walls are removable without releasing the side forms. Provide seals around reinforcement and water stop to prevent mortar leaks.
2. Overlap the hardened concrete of the first pour with forms for the second pour. Brace the ends of the forms against the hardened concrete to prevent joint offsets and mortar leakage. Align any exterior features required on the finished surface.

### 3.4 CONCRETE JOINTS

- A. General
1. Provide joints:
- a. As shown on the Drawings and as noted below in these Specifications.
- b. As required for constructability
- c. After favorable review of layout, sequence and concrete placement program.
2. Provide minimum curing times before the second placement:
- a. 2 days after the first concrete placement at the joint.

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- b. 10 days after each adjacent concrete placement, for infill pours or checkerboard placement pattern.

B. Control Joints:

1. Space typical control joints in slabs on grade or suspended slabs not exceeding 10 feet, or as shown on the Drawings. Control joints shall not be provided in water containment structures.
2. If cast-in with the concrete, positively locate the preformed joint filler and hold rigidly in place during concreting.
3. If saw-cut, use a wheeled power saw as soon as the concrete surface is firm enough. Saw-cut control joints must be constructed within 12-hours after concrete placement. Fill the groove with sealant over a backer rod.

C. Construction Joints:

1. Produce quality concrete, with full continuity of reinforcing and water tightness across the joints.
2. Space typical slab joints not exceeding 20 feet in the direction of the transverse or secondary reinforcing, typically the smaller reinforcing nearer to the center of the slab thickness. Space typical vertical wall joints no more than 30 feet apart.
3. Provide all joints in walls and slabs, retaining liquids, or earth with 6-inch waterstops. Continue all reinforcing through the joint unless otherwise noted.
4. After the first concrete placement at the joint, do not walk on or disturb any reinforcing extending into the second placement area for at least 48 hours.
5. Before depositing new concrete on or against concrete that has hardened, clean and roughen the entire surface of the joint exposing clean coarse aggregate solidly embedded in mortar matrix. Provide typically 1/4-inch roughness or amplitude of the concrete surface measured from the top of the exposed aggregate to the bottom of pockets between stones.
6. Drench the prepared joint with clean water and remove prior to the concrete pour.
7. Cover horizontal wall joints and wall-to-slab joints with a minimum thickness of 2 inches and a maximum of 6 inches of the modified concrete mix, consisting of the designated concrete mix with one-half of the coarse aggregate removed.

8. Use special care in vibrating adjacent to construction joints to ensure thorough consolidation of the concrete around the waterstops and against the hardened portion of the joint. Additional hand tamping may be required.
9. For joints that are shown on architectural drawings as having a continuous reveal or recess, leave the wood form or pour strip used to create the reveal or recess in place or re-insert before roughening. Prevent the next concrete placement from filling the reveal or recess.

D. Expansion Joints

1. Stop all steel reinforcing clear of the joint at each side.
2. Provide 9-inch center bulb waterstop continuously around the joint in walls and slabs retaining liquids.
3. Prepare a smooth first concrete surface with all voids filled.
4. Provide preformed joint filler, securely fastened to the existing concrete as directed by the Manufacturer.
5. Install bond breaker and sealant after curing is completed and when directed.

E. Bonding to Pre-existing Concrete: Mechanically roughen the old surface to a 1/4-inch amplitude, as defined in construction joint paragraph above. Apply epoxy bonding material prior to concreting, as recommended by the manufacturer.

F. Waterstop

1. Restrict field splices to butt joints in straight runs. For PVC type, make by heat welding, using a splicing iron. For rubber, provide sleeve joints and glue. Follow the manufacturer's specifications.
2. Positively locate and support in the forms so that concrete may be placed, consolidated, and vibrated on both sides of the embedded portion without displacement of the waterstop and without causing voids in the concrete. Protect the outstanding portion from damage during the first concrete pour and clean and positively support prior to the second pour. Place, consolidate and vibrate the second pour without displacement of the waterstop and without causing voids in the concrete.

### 3.5 CONCRETE CURING

A. Exposed concrete surfaces shall be protected from premature drying by covering as soon as possible with canvas, plastic sheets with sealed joints, burlap, sand or other satisfactory materials and kept continuously moist; or, if the surfaces are not covered, they shall be kept continuously moist by flushing or sprinkling.

1. Curing shall continue for a period of not less than 7 days after placing the concrete. If curing compound is used, two (2) applications will be made for even coverage. Curing methods must be approved by the Engineer.

### 3.6 FINISHING

- A. Defective and honeycombed surfaces shall be chipped back to such a depth to expose solid concrete. The surface shall be dampened and coated with a bonding agent and packed with mortar.
- B. Concrete Finishes for Vertical Wall Surfaces:
  1. Form facing material shall produce a smooth, hard, uniform texture.
    - a. Use forms specified for surfaces exposed to view in accordance with the Plans and other Specification Sections.
  2. At a minimum, repair the following surface defects:
    - a. Tie holes
    - b. Honeycombs deeper than  $\frac{1}{4}$ "
    - c. Air pockets deeper than  $\frac{1}{4}$ "
    - d. Rock holes deeper than  $\frac{1}{4}$ "
    - e. Scabbing
  3. Chip or rub off fins exceeding  $\frac{1}{8}$ " in height.
  4. Provide SF/ESF 3.0 finish and a smooth-rubbed finish for:
    - a. Walls being waterproofed, painted, coated with some other material.
    - b. Use at all exposed surfaces not specified to receive another finish.
- C. Related Uniform Surfaces (Except Slabs):
  1. Strike smooth tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces after concrete is placed.
  2. Float surface to a texture consistent with that of formed surfaces.
  3. Continue treatment uniformly across unformed surfaces.
- D. Concrete Finishes for Horizontal Slab Surfaces:

1. General: Tamp concrete to force coarse aggregate down from surface. Screed with straightedge, eliminate high and low places, bring surface to required finish elevations; slope uniformly to drains. Dusting of surface with dry cement or sand during finishing processes not permitted.
2. Slab Finish shall be as follows:
  - a. Surfaces intended to receive damp proofing or water proofing membranes: Float finish.
  - b. Floors intended to receive floor coverings and MCC rooms: Trowel finish.
  - c. Sidewalks, garage floors, drive-throughs and ramps: Broom finish.
  - d. Exterior slabs, platforms, steps and landings, exterior and interior pedestrian ramps and interior stairs and all process equipment areas, not covered by other finish materials: Broom finish.
3. Deviation in finish surface shall not exceed ¼” in 10 ft.
4. No tolerance will be allowed that will result in the maximum running, or cross, slope exceeding the requirements of the Americans with Disabilities Act.

### 3.7 TESTING

- A. Testing of concrete shall be as required by the Engineer and in accordance with ACI 301, Chapter 16.
  1. All costs of initial testing will be paid by the Owner unless otherwise noted.
  2. All costs involved, including those required by the Engineer, in retesting of concrete required because of a failure to meet these Specifications shall be at the expense of the Contractor.

### 3.8 WATERTIGHTNESS OF CONCRETE WORK

- A. It is the intent of this Specification to obtain concrete and grout with homogenous structure, which when hardened will have the required strength, is watertight, and resistance to weathering.

### 3.9 HYDRAULIC TESTINGS OF STRUCTURES

- A. It is the intent of this Specification to obtain concrete and grout with homogenous structure, which when hardened will have the required strength, watertightness, and resistance to weathering.
- B. General: Test all concrete tanks, hydraulic channels, sumps, basins and other structures designed to contain water, after concrete has reached the design

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strength, prior to backfilling, and application of any coating system. Test shall be performed by filling the structure with water.

C. Preparation: Provide the following.

1. All water necessary for testing shall be of acceptable Quality.
2. All evaporation and level measuring devices required.
3. All pumps, power, piping and any other equipment required. Make all hook-ups necessary to fill tanks for testing.
4. The water disposal method after testing is complete, including pumping if necessary.
5. Fill the structure with water to the extreme high operating surface level or to overflow weir level. Furnish and install temporary bulkheads, if required.
6. Maintain full for 48 hours before beginning the test period to permit concrete absorption and adjustment of valves, slide gates, or temporary bulkheads.
7. At completion of tests remove all temporary piping and connections. Dispose of wastewater without creating a nuisance of damage to adjacent property.

D. Test Period: Five consecutive 24 hour periods totaling 5 consecutive days. Take daily measurements of air and water temperature, rainfall and water level.

E. Test Procedure:

1. After test period, measure water level at each side of the tank to determine leakage and loss from evaporation.
2. Determine evaporation loss, using a standard 48-inch evaporation pan and level measuring device located adjacent to the tank.
3. Mark all observed damp areas, running or dripping leaks on exposed surfaces that have not healed autogenously during the test. Damp areas includes areas if moisture can be transferred from the exterior surface to a dry hand. Repair all those areas.
4. If leakage from the structure exceeds that permitted for the types of mechanical equipment providing closure plus 0.075% of the storage capacity, in each 24-hour period over a period of five consecutive days, perform a retest after completing repairs.
5. Provide acceptable procedures prior to repairs. Repairs by painting or surface treatment will not be acceptable.

6. Continue the test and repair procedure until the structure satisfies both the leakage calculation requirement and the visible leakage requirement.
- F. Test for Manholes
1. Furnish and dispose of water used for testing.
  2. Hydraulically test all manholes installed.
  3. After all pipe has been laid, backfilling has been completed, and after the testing of the pipes, plug the end of the pipe stubs in each manhole with flexible-joint caps, or acceptable alternate, securely fastened.
  4. Fill the manhole with water and measure leakage over a period of not less than one hour.
  5. Allowable Leakage: less than one (1) gallon per hour per 10-foot depth of manhole.
  6. When leakage from the manhole exceeds the above amount, determine the source or sources of the leakage, and repair or replace defective materials and workmanship.
  7. Repair all visible leaks even if manhole passes the leakage test.

**END OF SECTION**



## **SECTION 03 33 15**

### **CONCRETE WALKS, CURBS, AND GUTTERS**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. The work of this section consists of constructing concrete walks, drive approaches, curbs, and gutters.

##### **1.2 RELATED WORK**

- A. Section 03 33 01 - Cast-in-Place Concrete (Site Work)
- B. Section 31 23 00 - Earthwork

##### **1.3 REFERENCES**

- A. Section 40 – Concrete Pavement, State Standard Specifications
- B. Section 90 – Portland Cement Concrete, State Standard Specifications

##### **1.4 SUBMITTALS**

- A. Submittals shall be in accordance with the General Provisions.
- B. As specified in Section 01 33 00 – Submittal Procedures

##### **1.5 QUALITY ASSURANCE**

- A. Concrete testing will be the responsibility of the Engineer at the Owner's expense. The Contractor shall cooperate by rerouting equipment or by temporarily closing the work area being tested.
  - 1. Strength Tests: Strength tests shall be made from each 100 cubic yards of concrete or fraction thereof each day. For each test, three cylinders shall be molded, one to be used for a 7-day test.
  - 2. Air Content and Slump Tests: At the time samples are taken for strength tests, the laboratory shall make slump and air content tests.

##### **1.6 PROJECT CONDITIONS:**

- A. Place concrete only when temperatures are above 35 degrees F, unless it is protected from freezing and approved in advance by the Engineer.

## **PART 2 PRODUCTS**

### **2.1 SELECT FILL**

- A. Dense, readily compactable material, free from vegetable matter and lumps of clay. Excavated material that meets this requirement may be used if approved.

### **2.2 BASE COURSE**

- A. Hard, durable particles of stone, gravel, or other finely divided mineral matter. All particles shall pass a 1-inch square mesh sieve and shall be uniformly graded from coarse to fine to produce a dense, compacted base.

### **2.3 CONCRETE**

- A. Materials: Materials, including cement, aggregates, water, and admixtures, shall meet the requirements of ASTM C94-90.

- 1. Cement: Type II.

- 2. Coarse Aggregate: Maximum size, 1-inch for hand methods, 3/4-inch for slip-form construction, and 1/2-inch for extruded curbs. For machine placed concrete, Contractor may, with Contracting Officer's approval, modify the aggregate grading specified in ASTM C94-90 to meet the recommendations of the manufacturer of the machine.

- a. Minimum Cement Content:

- 1) Sidewalks, curbs and gutters: Class "B" (5 sack).

- 2) Driveways and cross gutters: Class "A" (6 sack).

- B. Slump:

- 1. Concrete Walks: Maximum 4 inches.

- 2. Curb and Gutter:

- a. Hand Vibrated: Maximum 3 inches.

- b. Slip-Formed: Maximum 2 inches.

- C. Strength: 4,000 psi for Type "A" and 3,000 psi for Type "B" at 28 days.

- D. Manufacture and Delivery: Measurement of materials, batching, mixing, transporting, and delivery shall be as specified in ASTM C94. Discharge concrete into forms within 1-1/2 hours after introduction of water to cement. When temperature of concrete is 85 degrees F or above, the time between introduction of water to cement and complete discharge of concrete into forms shall not exceed 45 minutes.

- E. Air Entraining Admixture: ASTM C260.
- F. Other admixtures complying with ASTM C494 or ASTM C618 may be used with approval of Engineer. No chlorides will be permitted.

#### 2.4 *EXPANSION JOINT FILLERS*

- A. ASTM D994-71, preformed bituminous type, 1/2-inch thick.

#### 2.5 *SURFACE RETARDANT*

- A. Rugasol S, manufactured by Sika Chemical Corporation, Lyndhurst, New Jersey, or approved equal.

#### 2.6 *CURING COMPOUND*

- A. In accordance with Section 90 of the State Standard Specifications.

#### 2.7 *CURING MATERIAL*

- A. Waterproof paper, polyethylene sheet, clean burlap, cotton mats, or other approved material that will not cause stain or discoloration.
- B. Using curing compound or curing materials, thoroughly cure and protect concrete keeping the surface moist for 7 days. Cure slabs with integral color in accordance with instructions of the pigment manufacturer. On exposed aggregate slabs or slabs with integral color, do not use polyethylene or paper sheeting.

### **PART 3 EXECUTION**

#### 3.1 *PREPARATION OF SUBGRADE*

- A. Excavate to required depth. Remove soft, yielding material and replace with select fill. Compact to a density of not less than 95 percent of the maximum density.

#### 3.2 *MAINTENANCE OF SUBGRADE*

- A. Maintain subgrade in a compacted condition until concrete is placed.

#### 3.3 *FORMS*

- A. Metal or uniform warp-free lumber, coated with form release agent. Grade forms to give slabs positive drainage and stake securely. Obtain approval of alignment and grade before placing concrete.

### 3.4 *PLACING:*

- A. Concrete slabs for walks shall be formed, placed, vibrated, and finished by hand using conventional methods. Concrete curbs or curbs and gutters may be constructed in the same manner, but Contractor has the option of machine placing curbs using the extrusion method or machine placing curb and gutter using the slip-form method.
- B. Place concrete on moistened subgrade monolithically between construction joints. Deposit to full depth in one operation. Consolidate immediately. After depositing concrete, screed and darby or bullfloat.

### 3.5 *FORM REMOVAL*

- A. Remove forms within 24 hours after concrete placement. Repair minor defects with mortar. Plastering will not be permitted on exposed faces.

### 3.6 *SLAB FINISHING*

- A. After darbying or bullfloating, stop finishing until bleeding has ceased and until concrete can support foot pressure with only about 1/4-inch indentation. Edge and joint, then float the slab. Use steel trowel to densify surface, then broom slab perpendicular to line of traffic.

### 3.7 *EXPOSED AGGREGATE FINISHING*

- A. Clean and thoroughly wet surface aggregate before use, and drain to prevent free water from entering the concrete.
- B. Evenly distribute aggregate by hand, covering surface with a single layer.
- C. Embed the surface aggregate by patting with the flat side of a strike-off board or other tool.
- D. When surface is firm, lightly hand float with a float or darby.
- E. Spray retardant on the surface according to manufacturer's recommendations.
- F. When the concrete has set up sufficiently, expose aggregate by simultaneously brushing and flushing with water without overexposing or dislodging the aggregate. Expose aggregate to a depth of 1/8 to 1/4 inch.

### 3.8 *JOINTS*

- A. Construct joints true to line with faces perpendicular to surface.
  - 1. Isolation Joints: Separate walks from walls, stairways, and other structures, using expansion joint fillers.

2. Contraction (Control) Joints: Space walk joints at intervals about equal to width of walk to a depth of one-fourth the slab thickness. Space curb and gutter joints not over 12 feet 6 inches on center, and align them with sidewalk joints. Contraction joints may be either sawn or tooled.
  - a. Sawn: Cut with a power saw fitted with an abrasive or diamond blade within 4 to 12 hours after walk has been placed and finished. Use sawn joints on exposed aggregate.
  - b. Tooled: Form plane of weakness by inserting and later removing a metal divider, finish with an edger or a groover, or by saw cutting a previously tooled joint.

### 3.9 *SIDEWALK RESTORATION*

- A. Where sections of miscellaneous sidewalk work requires removal and restoration the following shall apply:
  1. The surface of the sidewalk shall match the existing weakened plane joints, score joints and construction joint patterns with the adjoining sidewalks or City or County standards.
  2. Where short sections of sidewalk have been removed for replacement, a minimum distance of three (3) feet section of sidewalk shall be removed or as directed by the Engineer.
  3. If curbs and gutters cannot be cut off square and neat, the entire curb and gutter shall be removed to the nearest weakened plane or expansion joint. No patching at joints will be permitted.

### 3.10 *FIELD QUALITY CONTROL*

- A. Surfaces shall not vary more than 5/16 inch when tested with a 10-foot straightedge, nor curb gutters and valley gutters shall not vary more than .03 feet from design grade.

**END OF SECTION**

## **SECTION 03 35 18**

### **CONCRETE CURE-SEALER-HARDENER**

#### **PART 1 GENERAL**

##### *1.1 RELATED DOCUMENTS*

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### *1.2 SUMMARY*

- A. Section Includes:
  - 1. Single application cure-sealer-hardener for new concrete floors.
  - 2. Single application sealer-hardener for cured concrete floors.
  - 3. Precautions for avoiding staining concrete before and after application.
- B. Related Sections:
  - 1. Division 03 Section “Cast-In-Place Concrete.”

##### *1.3 REFERENCES*

- A. ASTM International (ASTM):
  - 1. ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  - 2. ASTM C779 Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
  - 3. ASTM C805 Standard Test Method for Rebound Number of Hardened Concrete.
  - 4. ASTM C1028 Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
  - 5. ASTM D3359 Standard Test Methods for Measuring Adhesion by Tape Test.

6. ASTM G23 Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials (Withdrawn 2000).

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For qualified installer.
- C. Maintenance Data: Maintenance instructions, including precautions for avoiding staining after application.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who is certified in writing by manufacturer as qualified to install manufacturer's products.
- B. VOC Content: Provide materials that comply with VOC limits of California Green Building Standards Code and Authority Having Jurisdiction.

#### 1.6 DELIVERY, STORAGE & HANDLING

- A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
- C. Handling: Protect materials from dirt, corrosion, oil, grease and other contaminants.

## PART 2 PRODUCTS

### 2.1 CURE-SEAL-HARDENER

- A. Basis of Design: Drawings and Specifications are based on the following:
  1. Curecrete Distribution, Inc.; Ashford Formula.
  2. Subject to compliance with requirements, submit specified product or a comparable product subject to request for substitution.
- B. Cure-Seal-Hardener: Water-based chemically reactive penetrating sealer and hardener that seals by densifying concrete so that water molecules cannot pass through but air and water vapor can, and allows concrete to achieve full compressive strength, minimizing surface crazing and eliminating dusting.

1. Abrasion Resistance to Revolving Disks: At least a 32.5% improvement over untreated samples when tested in accordance with ASTM C779.
  2. Surface Adhesion: At least a 22% increase in adhesion for epoxy when tested in accordance with ASTM D3359.
  3. Hardening: As follows when tested in accordance with ASTM C39:
    - a. After 7 Days: An increase of at least 40% over untreated samples.
    - b. After 28 Days: An increase of at least 38% over untreated samples.
  4. Coefficient of Friction: 0.86 dry, 0.69 wet when tested in accordance with ASTM C1028.
  5. Rebound Number: An increase of at least 13.3% over untreated samples when tested in accordance with ASTM C805.
- C. Light Exposure Degradation: No evidence of adverse effects on treated samples when tested in accordance with ASTM G23.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for conditions affecting performance of the Work of this Section.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Do not use frozen material. Thaw and agitate prior to use.
- D. If construction equipment must be used for application, diaper all components that might drip oil, hydraulic fluid or other liquids.

#### **3.3 INSTALLATION**

- A. General: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.



1. Apply cure-seal-hardener to exposed interior concrete floor slabs indicated to have a sealed concrete finish.
- B. New Concrete: Apply cure-seal-hardener to new concrete as soon as the concrete is firm enough to work on after troweling.
1. Spray on at rate of 200 ft<sup>2</sup>/gal (5 m<sup>2</sup>/L).
  2. Keep surface wet with cure-seal-hardener for a minimum soak-in period of 30 minutes without allowing it to dry out or become slippery. In hot weather, slipperiness may appear before the 30 minute time period has elapsed, if slipperiness occurs, apply additional cure-seal-hardener as needed to keep the entire surface in a non-slippery state for the first 15 minutes. For the remaining 15 minutes, mist the surface as needed with water to keep the material in a non-slippery state. In hot weather conditions, follow manufacturer's special application procedures.
  3. When the treated surface becomes slippery after this period, lightly mist with water until slipperiness disappears.
  4. Wait for surface to become slippery again, and then flush entire surface with water to remove all cure-seal-hardener residue.
  5. Squeegee surface completely dry, flushing any remaining slippery areas until no residue remains.
  6. Wet vacuum or scrubbing machines may be used in accordance with manufacturer's instructions to remove residue.

### 3.4 PROTECTION

- A. Protect installed floors for at least 3 months until chemical reaction process is complete.
1. Do not allow traffic on floors for 3 hours after application.
  2. Do not allow parking of vehicles on concrete slab.
  3. If vehicles must be temporarily parked on slab, place dropcloths under vehicles during entire time parked.
  4. Do not allow pipe cutting using pipe cutting machinery on concrete slab.
  5. Do not allow temporary placement and storage of steel members on concrete slabs.
  6. Clean up spills immediately and spot-treat stains with degreaser or oil emulsifier.
  7. Clean floor regularly in accordance with manufacturer's recommendations.

**END OF SECTION**

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**SECTION 03 60 00**

**GROUT**

**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- A. Epoxy grouting of anchor bolts and reinforcing bars to be installed in hardened concrete.
- B. Adhesive bonding of fresh concrete to existing hardened concrete surfaces.
- C. Installation of pipe and sleeve into existing concrete.
- D. Structure and Equipment leveling pads.

**1.2 RELATED WORK**

- A. Section 03 15 20 - Anchor Bolts & Post-Installed Anchors
- B. Section 03 30 00 - Cast-in-Place Concrete

**1.3 SUBMITTALS**

- A. As specified in the General Conditions and Section 01 33 00 – Submittal Procedures.

**PART 2 PRODUCTS**

Material Type	Approved Product
1. Non-shrinking Grout	L&M Chemical "Crystex", Gifford-Hill "Supreme", Master Builders "Masterflow 713 Grout" Sauereisen Cements "F-100 Level Fill Grout", U.S. Grout "Five Star Grout", UPCO "Upcon High Flow" or "Upcon Super Flow", or equal.
2. Epoxy Grout	
a. Adhesive, Moisture insensitive	
For floors and horizontal surfaces	Adhesive Engineering "Concressive 1539", Rescon "Concrete Bonder R616", or equal
For vertical walls or overhead applications, non-sagging consistency	Adhesive engineering "Concressive 1440" Rescon "Concrete Bonder R616" or equal
b. Aggregate	As recommended by the epoxy grout manufacturer
3. Epoxy Bonding Adhesive	Sikadur 32, Hi-Mod Master Builders Concressive Standard Liquid or equal.
4. Water	Clean and free from deleterious substances.

- A. Non-shrinking grout shall be furnished factory premixed, so only water is added at jobsite. Grout shall be mixed in a mechanical mixer. No more water shall be used than is necessary to produce a flowable grout.
  - 1. Cured grout shall have a minimum compressive strength of 3500 psi.
- B. Epoxy grout shall consist of a two component liquid epoxy adhesive of appropriate viscosity for the application and location and an inert aggregate filler component. Components shall be packaged separately at the factory and field mixed. All proportioning and mixing of the components shall be in accordance with the manufacturer's recommendations.
  - 1. Cured grout shall have a minimum compressive strength of 3500 psi.

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. The concrete surface to receive non-shrinking grout shall be saturated with water for 24 hours prior to grouting.
- B. Where indicated on the drawings, dowels shall be epoxy grouted in holes drilled into hardened concrete. Hole diameter shall be as recommended by the manufacturer. The embedment depth for epoxy grouted dowels shall be as indicated on the Plans.
- C. Holes shall be prepared for grouting as recommended by the grout manufacturer.
- D. The existing concrete surface to receive fresh concrete shall be clean and sound. The existing surface may be dry or damp, but free of standing water, free of dust, laitance, grease, airing compounds, and disintegrated materials. The existing concrete surface and rebar shall be sand blasted or cleaned by approved mechanical methods.

#### **3.2 INSTALLATION**

- A. Non-shrinking Grout
  - 1. Placement - Unless otherwise specified or indicated on the Plans, the thickness of grout shall be 1-1/2 inches. Grout shall be placed in strict accordance with the directions of the manufacturer.
  - 2. Edge Finishing - The grout shall be finished smooth in all locations where the edge of the grout will be exposed to view after it has reached its initial set. Except where indicated to be finished on a slope, the edges of grout shall be cut off flush at the base plate, bedplate, member, or piece of equipment.

3. Curing – Non-shrinking grout shall be protected against rapid loss of moisture by covering with wet rags or polyethylene sheets. After edge finishing is complete, the grout shall be wet cured for at least 7 days.
  4. Epoxy Grout - Dowels shall be clean, dry, and free of grease and other foreign matter at time of installation. The bars shall be set and positioned and the epoxy grout shall be placed and finished in accordance with the recommendations of the grout manufacturer. Particular care shall be taken to ensure that all spaces and cavities are filled with epoxy grout, without voids.
- B. Epoxy Bonding Adhesive: Pre-mix each component as specified by manufacturer. Mix only that quantity that can be applied within its pot life. Apply as specified by manufacturer.

**END OF SECTION**

## SECTION 05 12 00

### STRUCTURAL STEEL FRAMING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section Includes:

- 1. Structural steel.
- 2. Grout.

- B. Related Sections:

- 1. Division 01 Section "Quality and Testing Requirements" for administrative and procedural requirements for quality assurance including independent testing requirements.
- 2. Division 05 Section "Steel Decking" for field installation of shear connectors through deck.
- 3. Division 05 Section "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.

##### 1.3 REFERENCED CODES AND STANDARDS

- A. Comply with pertinent provisions of the following codes and standards:

- 1. California Code of Regulations, Title 24, Part 2, California Building Code, 2016 Edition.
- 2. American Institute of Steel Construction (AISC) Publications:
  - a. Code of Standard Practice for Steel Buildings and Bridges, April 14, 2010 (AISC 303-10).
  - b. Quality Criteria and Inspection Standards, latest Edition.
  - c. Manual of Steel Construction, 14<sup>th</sup> Edition.
  - d. Specification for Structural Steel Buildings, June 22, 2010 (AISC 360-10).
  - e. Seismic Provisions for Structural Steel Buildings including Supplement No. 1, March 9, 2010 and November 16, 2010 respectively (AISC 341-10).
- 3. American Welding Society (AWS):

- a. D1.1-10 Structural Welding Code - Steel.
  - b. D1.8-09 Structural Welding Code – Seismic
4. Steel Structures Painting Council (SSPC):
- a. Steel Structures Painting Manual, Vol. 2, Systems and Specifications, latest edition.
5. Federal Specifications:
- a. FF-W-84A, Washers, Lock (Spring).
6. Research Council on Structural Connections of the Engineering Foundation (RCSC):
- a. CRD-C621 Non-Shrink Grouts.
  - b. Specification for structural joints using ASTM A325 or A490 Bolts, December 31, 2009.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
  1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
  2. Include embedment drawings.
  3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
  4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
- C. Qualification Data: For fabricator and installer.
- D. Welding certificates.
- E. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- F. Certified mill test reports for structural steel, including chemical and physical properties.
- G. Source quality-control reports.
- H. Affidavit signed by the fabricator stating the structural steel furnished meets the requirements of the grade specified.

## 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator who employs adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. The Fabricator shall have completed a project of similar size and scope, and shall have adequate facilities, personnel, and equipment to meet production and quality requirements to maintain proper job progress. Certification by the AISC Quality Certification Program will provide satisfactory evidence of compliance.
- B. Installer Qualifications: A qualified installer who employs adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. Certification by the AISC Quality Certification Program will provide satisfactory evidence of compliance.
- C. Contractor Qualifications: The Contractor shall have completed a project of similar scope and shall have adequate facilities, personnel, and equipment to meet production and quality requirements to maintain proper job progress. Certification by the AISC Quality Certification Program will provide satisfactory evidence of compliance.
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel" and AWS D1.8/D1.8M, "Structural Welding Code – Seismic Supplement."

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
  - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
  - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.



## 1.7 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

## PART 2 - PRODUCTS

### 2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992.
  - 1. For shapes that are part of the lateral force resisting system with flange thickness exceeding 1-1/2 inches and other shapes with flange thickness exceeding 2 inches, conform to the Supplementary Requirements of ASTM A6.
    - a. S30, Charpy V-Notch Impact Test for structural shapes: Alternate core location. Test to minimum average value of toughness of 20 ft-lb at 70°F.
- B. Plate, Bar, Channels, and Angles: ASTM A 36 (A572 when specified).
  - 1. For plate 2 inches and thicker, conform to the Supplementary Requirements of ASTM A6.
    - a. S5, Charpy V-Notch Impact Test. Test to minimum average value of toughness of 20 ft-lb at 70°F.
- C. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- D. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
  - 1. Weight Class: Standard unless otherwise indicated on Drawings.
  - 2. Finish: Black except where indicated to be galvanized.
- E. Welding Electrodes: Comply with AWS requirements, electrodes shall be compatible with the base material being welded. For welds designated as demand critical as part of the lateral force resisting system, filler metal shall have Charpy V-Notch rating per AISC 341. For filler metals used in combination with filler metals of different processes, provide certification of Charpy V-Notch compatibility per AISC 341 and AWS D1.8.
  - 1. Shielded Metal Arc Welding: AWS A5.1, E70XX.
  - 2. Submerged Arc Welding: AWS A5.17, E7X.
  - 3. Self-Shielded flux core - NR 233.

## 2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. General: Provide hot dip zinc coated fasteners for exterior locations.
- B. Bolts and Nuts:
  - 1. General Use: Regular hexagon head type, ASTM A307, Grade A.
  - 2. High Strength: Where high strength bolting is noted on drawings, bolts and nuts shall conform to following:
    - a. Bolts: ASTM A325, Type 1 or 2.
    - b. Nuts: ASTM C563.
- C. Anchor Rods, Anchor Bolts, and Nuts:
  - 1. General Use: ASTM F1554, Grade 36 (36ksi).
  - 2. High Strength: ASTM F1554, Grade 55 (55ksi) with Supplementary Requirement No. 1 or Grade 105 (105ksi) where specified.
  - 3. Provide color coding per ASTM F1554 at each exposed end of anchor rods.
- D. Washers: Washers shall be suitable for use intended and as follows:
  - 1. Circular washers shall be flat and smooth and conform to the requirements of ANSI B18.22.1, Type A.
  - 2. Washers for high strength bolts shall conform to ASTM F436.
  - 3. Plate Washers shall conform to the requirements of ASTM A36
  - 4. Beveled washers for American Standard beams and channels shall be square or rectangular, shall taper in thickness and shall be smooth.
  - 5. Lock washers shall conform to FF-W-84.
- E. Welded Studs, Connectors, and Anchors: ASTM A 108, Grades 1015 through 1020, AWS D1.1.
  - 1. Threaded Studs: Nelson type CPL threaded studs.
  - 2. Shear Connectors: Nelson type S3L shear connector studs.
  - 3. Deformed bar anchors: Nelson D2L deformed bar anchors.
  - 4. Concrete Anchors: Nelson H4L concrete anchors.
- F. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
- G. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

## 2.3 PRIMER

- A. Primer: Fabricator's standard lead free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- B. Galvanizing Repair Paint: ASTM A 780.

## 2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time, and having the following characteristics:
1. Be capable of producing a flowable grouting material having no drying shrinkage or settlement at any age.
  2. Compressive strength of grout (2 inch cubes) shall be not less than 5,000 psi at age seven days and 7,500 psi at age 28 days.
  3. Conform to Corps of Engineers CRD-C621.
- B. Dry Pack Grout: 2 parts sand to 1 part cement.

## 2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303 "Code of Standard Practice for Steel Buildings and Bridges," AISC 360 "Specification for Structural Steel Buildings," and AISC 341 "Seismic Provisions for Structural Steel Buildings including Supplement No. 1."
1. Camber structural-steel members where indicated.
    - a. Camber horizontal members in accordance with AISC 360 Spec. Section M2. Do not use purely mechanical means to reverse over cambered beams.
  2. Fabricate beams with rolling camber up.
  3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
  4. Mark and match-mark materials for field assembly.
  5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
  2. Thermal cutting will be permitted only with the specific approval of the Architect.
  3. Stresses shall not be transmitted through thermally cut surfaces unless such surfaces are cut by a mechanically guided torch.
  4. The radius of re-entrant flame cut fillets shall be as large as possible, but never less than one-half inch.
  5. All Thermal cutting shall be smooth and regular in contour per AWS.
  6. The net area of thermally cut members shall be determined by deducting one-eighth inch from the cut edges not made by a mechanically guided torch.

- C. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
  - 1. Holes: Cut holes perpendicular to steel surfaces by cutting, drilling, or punching holes, do not thermally cut bolt holes or enlarge holes by burning.
  - 2. Weld threaded nuts to framing and other specialty items indicated to receive other work.
  - 3. Remove outside burrs resulting from drilling or reaming operations with a tool making a 1/16 inch radius.
  - 4. Make bolt holes 1/16 inch oversize typical. Anchor bolt holes in column base plates shall be oversized per drawings..
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Welded Construction:
  - 1. The location and type of all welds shall be as shown on the drawings. No weld splices shall be made except as shown.
  - 2. All welds shall be made by the electric shielded arc or the submerged-arc methods. The welding sequence and technique of welding shall be carefully controlled to minimize locked-up stresses and distortion.
  - 3. Visible welded joints shall be considered "finished" welds and shall be carefully executed to preclude the necessity of grinding or otherwise finishing. However, when the appearance of the weld is unacceptable, in the opinion of the Architect, grinding shall be of the highest standard for both field and shop practice.
- F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted as follows:
  - 1. Remove oil, grease, and similar contaminants in accordance with SSPC-SP-1.
  - 2. Clean off heavy rust and loose mill scale in accordance with SSPC-SP-2 or SSPC-SP-3.
- G. Welded Threaded Studs, Shear Connectors, and Concrete Anchors: Prepare steel surfaces and automatically end weld studs and concrete anchors in accordance with AWS D1.1/D1.1M and the manufacturer's recommendations in such a manner as to provide complete fusion between the end of the stud and the plate. There should be no porosity or evidence of lack of fusion between the welded end of the stud and the plate. The stud shall decrease in length during welding approximately 1/8 inch for studs up to 5/8 inch in diameter, and approximately 3/16" in length for studs over 5/8 inch diameter.

## 2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified. Each member of the bolting crew applying high strength bolts shall be assigned an identification mark or symbol which shall be applied to each joint worked.

- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work. In addition, comply with AWS D1.8/D1.8M for “High Seismic Applications” as defined in AISC 360 where applicable.
  - 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

## 2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
  - 2. Surfaces to be field welded.
  - 3. Surfaces to be high-strength bolted with slip-critical connections.
  - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
  - 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  - 1. Remove oil, grease, and similar contaminants in accordance with SSPC-SP-1.
  - 2. Clean off heavy rust and loose mill scale in accordance with SSPC-SP-2 "Hand Tool Cleaning," or SSPC-SP-3 "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
  - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

## 2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
  - 1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
  - 2. Galvanize structural steel framing items located in exterior walls and where indicated on drawings.

## 2.9 SOURCE QUALITY CONTROL

- A. Waiver of Source Quality Control: Source quality control testing shall not be required when fabricator participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant.
- B. Testing and Inspecting Agency: Owner will engage and pay for a qualified independent testing and inspecting agency to perform tests and inspections as applicable and prepare reports.
1. Provide testing and inspecting agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
  2. Testing and inspection agency shall be acceptable to the Architect
- C. The Architect shall have the right to order the testing of any materials used in the steel construction to determine if they are of the quality specified.
- D. Testing and Inspection Services: The following tests and inspections shall be performed by the designated laboratory.
1. Steel Testing:
    - a. All steel used for structural purposes shall be identified as required by 2016 CBC Section 2203.1. Manufacturer's mill analyses and test reports are acceptable for properly identified steel, but the enforcement agency may require additional testing to determine the quality of the steel if there is any doubt as to its acceptability. Any steel not properly identified shall be tested to meet the minimum chemical and mechanical requirements of the ASTM standard appropriate for the steel specified for the structure.
    - b. Fabrication shall not commence until steel members designated on the Structural Testing and Inspection Schedule have been tested. Tests shall be made by an independent testing laboratory approved by the Architect. Reports certifying that the materials and workmanship conform to the contract documents shall be submitted to the Architect.
  2. Inspection of Welding: Shop welding operations including the installation of automatic end-welded stud shear connectors shall be inspected by a certified Welding Inspector meeting the requirements of AWS QC1. The Fabricator shall schedule their operations to provide a minimum of 24 hours notice to the welding inspector so that all welding operations may be inspected.
    - a. The Welding Inspector shall make a systematic record of all welds; recording shall include the following:
      - 1) Names and identification marks of welders.
      - 2) List of defective welds.
      - 3) Manner of correction of defects.
    - b. The Welding Inspector shall check the material, equipment, procedure, welds, and the ability of each welder.

- c. Acceptance criteria shall be based on statically loaded connections. Upon detection of a rejectable weld, the inspector shall notify the Contractor, and observe removal of defects and repairs.
- d. The welding inspector shall tag or stamp accepted weldments with the inspector's identification stamp.
- e. A report stating that the welding they are required to inspect, is proper and has been done in conformity with approved drawings and specifications shall be furnished to the Architect.
- f. Welding inspections, testing and frequency shall conform to AWS D1.1, AWS D1.8 and related AISC documents. The Welding Inspector shall use all means necessary to determine the quality of the welds. However, the following tests and inspections shall be performed as a minimum:

1) Visual Inspection of Welding:

- a) Observe multi-pass and full penetration welds continuously (i.e. the welding inspector shall be present at all times).
- b) Observe single pass fillet welds periodically. The inspector shall check the qualifications of the welders at the start of the work and then make final inspection of all welds for compliance prior to completion of welding.
- c) After the welding is completed, Contractor shall hand or power nylon brush welds, and thoroughly clean them before inspection.
- d) Inspect welds with magnifiers under strong, adequate light for surface cracking, porosity, and slag inclusions; excessive roughness; unfilled craters; gas pockets; undercuts; overlaps; size; and insufficient throat and concavity.
- e) Inspect the preparation of groove welds for adequate throat opening and for snug positioning of back-up bars.
- f) Check the type and size of electrodes to be used for the various joints and positions. Check the storage facilities to see if they are adequate to keep the electrodes dry.
- g) Verify the use of proper pre-heat and interpass temperatures.
- h) Observe the technique of each welder periodically with the use of a welding inspection shield.

2) Nondestructive Testing of Welding:

- a) Welds shall be non-destructive tested by one of the following methods in accordance with AWS D1.1 and AWS D1.8 at testing agency's option or as required by AWS or AISC at the frequency noted below:

<u>Test Method</u>	<u>Frequency</u>
Liquid Dye Penetrant Testing ASTM E165	When requested by Architect.
Magnetic Particle Testing	10% of all fillet welds and 100%

ASTM E709	of all full penetration welds on members thinner than 5/16".
Ultrasonic Testing ASTM E164	100% of all full penetration welds on members thicker than 5/16"
Radiographic Testing ASTM E94	When requested by Architect or as substitute for magnetic particles testing or ultrasonic testing.

- b) Reduced Frequency of Ultrasonic Testing: Initially, all welds requiring 100% testing shall be tested at the rate of 100% in order to establish the qualifications of each individual welder. If the reject rate is demonstrated to be less than 5% of the welds tested for each welder, then the frequency of testing for that welder may be reduced to 25%. If the reject rate increases to 5% or more, 100% testing shall be re-established until the rate is reduced to less than 5%. The percentage of rejects shall be calculated for each welder independently. A sample of at least 40 completed welds shall be made for such reduction evaluation. Reject rate is defined as the number of welds containing rejectable defects divided by the number of welds completed. For evaluating the reject rate of continuous welds over 3 feet in length, each 12 linear inch increment of welds, one inch or less in thickness, shall be considered one weld. For evaluating the reject rate of continuous welds greater than 1 inch thickness, each 6 linear inches shall be considered one weld.
- c) Reduced Frequency of Magnetic Particle Testing: Initially, all welds requiring 100% testing shall be tested at the rate of 100% in order to establish the qualifications of each individual welder. If the reject rate is demonstrated to be less than 5% of the welds tested for each welder, then the frequency of testing for that welder may be reduced to 10%. If the reject rate increases to 5% or more, 100% testing shall be re-established until the rate is reduced to less than 5%. The percentage of rejects shall be calculated for each welder independently. A sample of at least 20 completed welds shall be made for such reduction evaluation. Reject rate is defined as the number of welds containing rejectable defects divided by the number of welds completed. This reduction is not permitted on welds in the K-area, at repair sites, weld tab and backing removal sites and access holes.
- g. Correction of Defective Welds: Weld areas containing defects exceeding the standards of acceptance in AWS D1.1 and AWS D1.8 shall be corrected in accordance with AWS D1.1, Section 3.7 and AWS D1.8. Additional testing of the repaired areas shall be required.



3. Welded Threaded Studs, Concrete Anchors, and Shear Connector Studs: Test and inspect installation in accordance with AWS D1.1. Random sample and test from stock furnished to each project. Tests shall meet the requirements of ASTM A108.
  - a. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
  - b. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.
4. Testing High Strength Bolts, Nuts and Washers: Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
  - a. Materials: If the manufacturer's certification is not available, sample and test bolts, nuts and washers in accordance with ASTM A325 or A490, shipping lot method.
  - b. Installation:
    - 1) Inspect slip critical connections and connections subject to direct tension in accordance with RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts.
    - 2) Tests shall be performed by an approved testing laboratory specifically approved for that purpose.
    - 3) The inspector shall check the materials, equipment, details of construction and installation procedure.
    - 4) The inspector shall furnish the Architect with a report that the work has been completed in every material respect in compliance with the approved drawings and specifications.
5. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
  1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

### 3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Erect steel in accordance with the AISC Specification Section M4 and AISC Code Section 7 Except as modified herein.
  - 1. Where parts cannot be assembled or fitted properly as a result of errors in fabrication or of deformation due to handling or transportation, report such condition immediately to the Architect and obtain approval for the methods of correction before proceeding with making any corrections.
  - 2. Do not heat heat-treated parts for straightening.
  - 3. Drain steelwork properly; fill pockets in structures exposed to the weather with an approved waterproof material.
  - 4. When calibrated wrenches are used for tightening bolts, calibrate them at least once each working day using not less than three typical bolts of each diameter.
- C. All structural steel framing shall be erected by experienced riggers and shall be carefully planned and laid out so that minimum cutting will be required. The work shall be erected plumb, square, and true to a line and level and in precise position as indicated. Temporary bracing, shoring and guys shall be introduced wherever necessary to provide for loads and stresses to which the structure may be subjected. Temporary bracing shall be left in place as long as may be required for safeguarding all parts of the work. As the erection progresses, the work shall be securely bolted up or welded, as required by the drawings to take care of all dead load, lateral forces and erection stresses.
- D. Provide anchor bolts and other connections required for securing structural steel to foundations and other in-place work. Furnish templates and other devices as necessary for setting bolts to accurate locations. Tighten anchor bolts after supporting members have been positioned and plumbed. Do not use impact torque wrenches to tighten anchor bolts set in concrete or masonry.
- E. Base Bearing and Leveling Plates: Clean concrete and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  - 1. Set plates for structural members on wedges, shims, or setting nuts as required to maintain plates in proper position while being grouted. Do not remove wedges

- or shims but, if protruding, cut off flush with edge of plate before packing with grout.
2. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure prior to imposing dead or live loading on columns. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- F. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of weld made, and methods in correcting welding work. Visible welded joints shall be considered "finished" welds and shall be carefully executed to preclude the necessity of grinding or otherwise finishing. However, when the appearance of the weld is unacceptable, in the opinion of the Architect, grinding shall be of the highest standard for both field and shop practice.
- G. Connections: Design connections for which details are not indicated in accordance with AISC "Manual of Steel Construction" for the full allowable shear capacity of the member.
- H. Temporary welds, run-off plates, and backing strips shall be removed where exposed in the final structure.
- I. Remove erection bolts on exposed, welded construction, fill holes with plug welds and grind smooth.
- J. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- K. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
  2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- L. Splice members only where indicated.
- M. Do not use thermal cutting during erection.
- N. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- O. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

### 3.4 FIELD QUALITY CONTROL

- A. Testing and Inspecting Agency: Owner will engage and pay for a qualified independent testing and inspecting agency to perform tests and inspections as applicable and prepare reports.
1. Testing and Inspection Agency shall be acceptable to the Architect.
- B. The Architect shall have the right to order the testing of any materials used in the steel construction to determine if they are of the quality specified.
- C. Contractor Responsibilities:
1. The Contractor shall maintain control of the quality of materials and workmanship in order to conform with the drawings and specifications.
  2. To facilitate testing and inspection, the Contractor shall:
    - a. Schedule tests and inspections with the Testing and Inspection Agency sufficiently in advance of operations to allow for the assignment of personnel and for the completion of testing and inspecting responsibilities.
    - b. Provide access to the Work for the designated Testing and Inspection Agency.
    - c. Furnish all necessary materials and labor to assist the designated Testing and Inspection Agency in obtaining and handling samples at the project or other sources of materials.
    - d. Provide and maintain for the sole use of the Testing and Inspection Agency adequate facilities for safe storage test specimens on the project site.
  3. The Contractor shall correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- D. Testing and Inspection Services:
1. Testing and inspections shall be performed by the designated Testing and Inspection Agency.
  2. Testing and inspections shall be in accordance with the 2016 California Building Code, Section 1704.4 and Table 1704.3.
  3. Steel Testing:
    - a. All steel used for structural purposes shall be identified as required by 2016 CBC Section 2203.1. Manufacturer's mill analyses and test reports are acceptable for properly identified steel, but the enforcement agency may require additional testing to determine the quality of the steel if there is any doubt as to its acceptability. Any steel not properly identified shall be tested to meet the minimum chemical and mechanical requirements of the ASTM standard appropriate for the steel specified for the structure.
    - b. Fabrication shall not commence until steel members designated on the Structural Testing and Inspection Schedule have been tested. Tests shall be made by an independent testing laboratory approved by the Architect.

Reports certifying that the materials and workmanship conform to the contract documents shall be submitted to the Architect.

4. Inspection of Field Erection:
  - a. Verify qualifications of field procedures and personnel.
  - b. Inspect erection of structural steel work for conformance with the drawings and specifications.
  
5. Inspection of Welding: Field welding operations including the installation of automatic end-welded stud shear connectors shall be inspected by a certified Welding Inspector meeting the requirements of AWS QC1. The Contractor shall schedule their operations to provide a minimum of 24 hours notice to the welding inspector so that all welding operations may be inspected.
  - a. The Welding Inspector shall make a systematic record of all welds; recording shall include the following:
    - 1) Names and identification marks of welders.
    - 2) List of defective welds.
    - 3) Manner of correction of defects.
  - b. The Welding Inspector shall check the material, equipment, procedure, welds, and the ability of each welder.
  - c. Acceptance criteria shall be based on statically loaded connections. Upon detection of a rejectable weld, the inspector shall notify the Contractor, and observe removal of defects and repairs.
  - d. The welding inspector shall tag or stamp accepted weldments with the inspector's identification stamp.
  - e. A report stating that the welding required to be inspected is proper and has been done in conformity with approved drawings and specifications shall be furnished to the Architect.
  - f. Welding inspections, testing, and frequency shall conform to AWS D1.1, AWS D1.8, and related AISC documents. The Welding Inspector shall use all means necessary to determine the quality of the welds. However, the following tests and inspections shall be performed as a minimum:
    - 1) Visual Inspection of Welding:
      - a) Observe multi-pass and full penetration welds continuously (i.e. the welding inspector shall be present at all times).
      - b) Observe single pass fillet welds periodically. The inspector shall check the qualifications of the welders at the start of the work and then make final inspection of all welds for compliance prior to completion of welding.
      - c) After the welding is completed, Contractor shall hand or power nylon brush welds, and thoroughly clean them before inspection.
      - d) Inspect welds with magnifiers under strong, adequate light for surface cracking, porosity, and slag inclusions; excessive

roughness; unfilled craters; gas pockets; undercuts; overlaps; size; and insufficient throat and concavity.

- e) Inspect the preparation of groove welds for adequate throat opening and for snug positioning of back-up bars.
- f) Check the type and size of electrodes to be used for the various joints and positions. Check the storage facilities to see if they are adequate to keep the electrodes dry.
- g) Verify the use of proper pre-heat and interpass temperatures.
- h) Observe the technique of each welder periodically with the use of a welding inspection shield.

2) Nondestructive Testing of Welding:

- a) Welds shall be non-destructive tested by one of the following methods in accordance with AWS D1.1 and AWS D1.8 at the frequency noted below:

<u>Test Method</u>	<u>Frequency</u>
Liquid Dye Penetrant Testing	When requested by Architect.
Magnetic Particle Testing	10% of all fillet welds and 100% of all full penetration welds on members thinner than 5/16".
Ultrasonic Testing	100% of all full penetration welds on members thicker than 5/16"
Radiographic Testing	When requested by Architect or as substitute for magnetic particles testing or ultrasonic testing.

- b) Reduced Frequency of Ultrasonic Testing: Initially, all welds requiring 100% testing shall be tested at the rate of 100% in order to establish the qualifications of each individual welder. If the reject rate is demonstrated to be less than 5% of the welds tested for each welder, then the frequency of testing for that welder may be reduced to 25%. If the reject rate increases to 5% or more, 100% testing shall be re-established until the rate is reduced to less than 5%. The percentage of rejects shall be calculated for each welder independently. A sample of at least 40 completed welds shall be made for such reduction evaluation. Reject rate is defined as the number of welds containing rejectable defects divided by the number of welds completed. For evaluating the reject rate of continuous welds over 3 feet in length, each 12 linear inch increment of welds, one inch or less in thickness, shall be considered one weld. For evaluating the reject rate of continuous welds greater than

1 inch thickness, each 6 linear inches shall be considered one weld.

- c) **Reduced Frequency of Magnetic Particle Testing:** Initially, all welds requiring 100% testing shall be tested at the rate of 100% in order to establish the qualifications of each individual welder. If the reject rate is demonstrated to be less than 5% of the welds tested for each welder, then the frequency of testing for that welder may be reduced to 10%. If the reject rate increases to 5% or more, 100% testing shall be re-established until the rate is reduced to less than 5%. The percentage of rejects shall be calculated for each welder independently. A sample of at least 20 completed welds shall be made for such reduction evaluation. Reject rate is defined as the number of welds containing rejectable defects divided by the number of welds completed. This reduction is not permitted on welds in the K-area, at repair sites, weld tab and backing removal sites and access holes.
  - g. **Correction of Defective Welds:** Weld areas containing defects exceeding the standards of acceptance in AWS D1.1 and AWS D1.8 shall be corrected in accordance with AWS D1.1, Section 3.7 and AWS D1.8. Additional testing of the repaired areas shall be required.
6. **Welded Threaded Studs, Concrete Anchors, and Shear Connector Studs:** Test installation in accordance with AWS D1.1. Random sample and test from stock furnished to each project. Tests shall meet the requirements of ASTM A108.
- a. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
  - b. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.
7. **Testing High Strength Bolts, Nuts and Washers:**
- a. **Materials:** If the manufacturer's certification is not available, sample and test bolts, nuts and washers in accordance with ASTM A325 or A490, shipping lot method.
  - b. **Installation:**
    - 1) Inspect slip critical connections and connections subject to direct tension in accordance with RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts.
    - 2) Tests shall be performed by an approved testing laboratory specifically approved for that purpose.
    - 3) The inspector shall check the materials, equipment, details of construction and installation procedure.

- 4) The inspector shall furnish the Architect with a report that the work has been completed in every material respect in compliance with the approved drawings and specifications.
8. Additional testing and inspecting will be performed to determine compliance of replaced or additional work with specified requirements.
    - a. The cost of additional testing and inspection of replaced work will be paid for by the Owner with the amount being deducted from the Contract Amount by a Change Order.

### 3.5 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION



## SECTION 05 40 00

### COLD-FORMED METAL FRAMING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Exterior wall framing.
  - 2. Roof joist framing.
- B. Related Sections include the following:
  - 1. Division 05 Section "Metal Fabrications" for miscellaneous framing with steel angles, channels, plates, and shapes.
  - 2. Division 09 Section "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

##### 1.3 STANDARDS AND REFERENCES

- A. California Code of Regulations, Title 24, Part 2, California Building Code, 2013 Edition.
- B. American Iron and Steel Institute (AISI) Specifications and Standards. Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
  - 1. Standard for Cold-formed Steel Framing – Header Design.
  - 2. Standard for Cold-formed Steel Framing – Lateral Design.
  - 3. Standard for Cold-formed Steel Framing – Wall Stud Design.
- C. ASTM International (ASTM):
  - 1. ASTM A 653, Steel Sheet, Zinc Coated (galvanized) or zinc-iron alloy-coated by the Hot Dip Process, Physical (Structural) Quality.
  - 2. ASTM A 1008, Steel Sheet, Cold-Rolled, Carbon, Structural, High Strength, Low Alloy with improved formability.
  - 3. ASTM A 1011, Sheet & Strip, Hot-Rolled, Carbon, Structural, High Strength, Low Alloy with improved formability.

4. ASTM C 645, Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.
5. ASTM C 754, Installation of Steel Framing Members to Receive Screw Attached Gypsum Board.
6. ASTM C 955, Load-Bearing (Transverse and Axial) Steel Studs, Runners (Track), and Bracing or Bridging for Screw Application of Gypsum Board and Metal Plaster Bases.
7. ASTM C 1007, Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.

D. Federal Specifications

1. FF-P-395, Pin, Drive, Guided and Pin Drive, Power Actuated (Fasteners for Power Actuated and Hand Actuated Fastening Tools..
2. FF-S-325, Shield, Expansion: Nail, Expansion: and Nail, Drive Screw (Devices, Anchoring Masonry).

E. American Welding Society (AWS) Publication:

1. D1.1, Structural Welding Code, Steel.
2. D1.3, Structural Welding Code, Sheet Steel.

F. Metal Lath/Steel Framing Association (ML/SFA) Publication:

1. ML/SFA 540, Lightweight Steel Framing Systems.
2. ML/SFA 541, Selection Guidelines: Lightweight Steel Framing.
3. ML/SFA 920, Guide Specifications for Metal Lathing and Furring.

G. Steel Stud Manufacturers Association (SSMA):

1. Product Technical Information, ICC ESR-3064P.

## 1.4 SUBMITTALS

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- B. Welding certificates.
- C. Research Reports: For cold-formed steel framing, from ICC-ES.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Use adequate number of skilled workmen who are thoroughly trained and experienced in the erection of cold formed steel framing and who are completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:

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1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling. Cover stored metal framing with a waterproof covering and ventilate to avoid condensation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:
  1. California Expanded Metal Products Company (CEMCO).
  2. ClarkDietrich Building systems.
  3. MarinoWare; a division of Ware Industries.

### 2.2 SHEET STEEL MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, or ASTM A653/A653M, metallic coated, of grade and coating weight as follows:
  1. Grade:
    - a. ST33H, 33 KSI for members 18 gauge (0.043 mils) and lighter in thickness.
    - b. ST50H, 50 KSI for members 16 gauge (0.054 mils) and heavier in thickness.
  2. Coating: G60 or equivalent.
- B. Steel Sheet for Vertical Deflection and/or Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
  1. Grade: 50, Class 1 or 2.
  2. Coating: G90 per ASTM C955.

### 2.3 FRAMING MEMBERS

- A. General: Provide framing members as indicated on Drawings and herein specified.
- B. Steel Studs and Joists: Manufacturer's standard C-shaped steel studs and joists of web depths indicated, stiffened flanges, and as follows:

1. Studs: Punched openings regularly spaced along webs.
  2. Joists: Un-punched webs.
  3. Minimum Base-Metal Thickness: As indicated on Drawings.
  4. Flange Width: As indicated on Drawings, 1-5/8 inches minimum.
  5. Section Properties: As indicated on Drawings.
- C. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
1. Minimum Base-Metal Thickness: Matching steel studs.
  2. Flange Width: 1-1/4 inches unless otherwise indicated.
- D. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes, matching studs, used to form header beams, of web depths indicated, punched, with stiffened flanges, and as indicated on the Drawings.
- E. Vertical Deflection Clips: Manufacturer's standard bypass or head clips as indicated on Drawings, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- A. Deflection Track: Single or double deflection track as indicated on Drawings.
1. Single Deflection Track: Manufacturer's deflection track as indicated on Drawings; single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, minimum base metal thickness matching studs.
  2. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges, minimum base metal thickness matching studs.

## 2.4 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

## 2.5 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: Conform to ASTM A307.
- C. Expansion Anchors: Size as indicated on Drawings; fabricated from corrosion-resistant materials; use one of the following:

1. Hilti Kwik Bolt TZ (ESR-1917).
  2. Simpson Strong-Tie Strong Bolt 2 Wedge Anchor (ESR-3037/IAPMO UES ER-240).
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, and conforming to Federal Specification FF-P-395.
1. Concrete Attachment: Use 0.157 inch diameter Hilti X-U pins with steel washers; embedment of steel pins into concrete shall not be less than 1-1/8 inch.
  2. Steel Attachment: Use 0.157 inch diameter Hilti X-U (ESR-2269) pins with steel washers; protrusion of steel pins through steel members shall not be less than 1/4 inch.
- E. Screw Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: E60XX electrodes complying with AWS standards.

## 2.6 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.
- C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.
- D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

## 2.7 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
1. Fabricate framing assemblies using jigs or templates.
  2. Cut framing members by sawing or shearing; do not torch cut.
  3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

- a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
  - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
  2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

### 3.3 FRAMING, GENERAL

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed metal framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
  - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
  - 1. Cut framing members by sawing or shearing; do not torch cut.
  - 2. Fasten cold-formed metal framing members by welding or screw fastening. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Drawings and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- H. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
  - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.4 WALL FRAMING

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings indicated on Drawings.

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- B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as indicated on Drawings and not to exceed 24 inches on center.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
  - 1. Frame wall openings as indicated on Drawings with not less than double studs at each side of jambs. Fasten jamb members together to uniformly distribute loads.
  - 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
  - 1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced 48 inches on center. Fasten at each stud intersection. Install bridging as indicated on Drawings, or if not indicated, install one of the following:
  - 1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to 6 inches deep.
  - 2. Bridging: Combination of flat, taut, steel sheet straps, 1-1/2 by 0.0329 inch, and stud-track solid blocking of matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
- J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.



- K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

### 3.5 JOIST FRAMING

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Drawings.
- B. Install joists bearing on supporting framing, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
  - 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
  - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Drawings.
- C. Space joists not more than 2 inches from abutting walls, and as indicated on Drawings.
- D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Drawings.
- F. Install bridging at intervals indicated on Drawings. Fasten bridging at each joist intersection as follows:
  - 1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
  - 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

### 3.6 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
  - 1. The Architect shall have the right to order the testing of any materials used in the steel construction to determine if they are of the quality specified.
- B. Field and shop welds will be subject to testing and inspecting.

- C. Testing agency will report test results promptly and in writing to Architect and Contractor.
- D. Responsibilities and Duties of Contractor:
1. Maintain control of the quality of materials and workmanship and to obtain conformance with the drawings and specifications.
  2. Facilitate testing and inspection as follows:
    - a. Furnish all necessary materials and labor to assist the designated testing laboratory in obtaining and handling samples at the project or other sources of materials.
    - b. Advise the designated testing laboratory sufficiently in advance of operations to allow for completion of quality tests and for the assignment of personnel.
  3. The Contractor shall correct deficiencies in cold-formed metal framing which inspections and laboratory test reports have indicated to be not in compliance with requirements.
- E. Testing and Inspecting: The following testing and inspecting shall be performed by the designated Testing and Inspection agency. Perform additional tests, as may be necessary to reconfirm any non-compliance of original work and as may be necessary to show compliance of corrected work.
1. Steel Testing:
    - a. Cold formed steel framing shall be identified as required by 2016 CBC Section 2203. Manufacture's mill analyses and test reports are acceptable for properly identified steel, but the enforcement agency may require additional testing to determine the quality of the steel if there is any doubt as to its acceptability. Any steel not properly identified shall be tested to meet the minimum chemical and mechanical requirements of the ASTM standard appropriate for the steel specified for the structure.
    - b. Fabrication shall not commence until steel members designated on the Structural Testing and Inspection Schedule have been tested. Tests shall be made by an independent testing laboratory approved by the Architect. Reports certifying that the materials and workmanship conform to the contract documents shall be submitted to the Architect and the Division of the State Architect.
  2. Shop Fabrication:
    - a. Inspection of shop fabrication of all members shall be performed by an independent testing laboratory approved by the Architect.
    - b. A report stating that all the materials and workmanship conform to approved drawings and specifications shall be submitted to the Architect.
  3. Field Erection:
    - a. Verify qualifications of field procedures and personnel.

- b. Inspect erection of cold formed steel work for conformance with the drawings and specifications.
4. Welding:
- a. All shop and field welding operations shall be inspected by a certified Welding Inspector meeting the requirements of AWS QC1 and who has been approved by the Architect. The Contractor shall schedule his operations to provide a minimum of 24 hours notice to the welding inspector so that all welding operations may be inspected.
  - b. The Welding Inspector shall be an individual trained and thoroughly experienced in inspecting welding operations. The Welding Inspector's ability to distinguish between sound and unsound welding shall be reliably established.
  - c. The Welding Inspector shall make a systematic record of all welds. This record shall include:
    - 1) Names and identification marks of welders.
    - 2) List of defective welds.
    - 3) Manner of correction of defects.
  - d. The Welding Inspector shall check the material, equipment and procedure as well as the welds. He shall also check the ability of the welder.
  - e. Upon detection of a rejectable weld, the inspector shall notify the Contractor, and observe removal of defects and repairs.
  - f. The welding inspector shall tag or stamp accepted weldments with the inspector's identification stamp
  - g. A report stating that the welding he is required to inspect, is proper and has been done in conformity with approved drawings and specifications shall be furnished to the Architect.
  - h. The Welding Inspector shall use all means necessary to determine the quality of the welds. Inspection procedures shall conform to AWS D1.3. However, the following tests and inspections shall be performed as a minimum:
    - 1) Visual Inspection of Welding:
      - a) Observe multi-pass and full penetration welds continuously (ie. the welding inspector shall be present at all times).
      - b) Observe single pass fillet welds periodically. The inspector shall check the qualifications of the welders at the start of the work and then make final inspection of all welds for compliance prior to completion of welding.
      - c) After the welding is completed, hand or power nylon brush welds, and thoroughly clean them before inspection.
      - d) Inspect welds with magnifiers under strong, adequate light for surface cracking, porosity, and slag inclusions; excessive roughness; unfilled craters; gas pockets; undercuts; overlaps; size; and insufficient throat and concavity.

- e) Inspect the preparation of groove welds for adequate throat opening and for snug positioning of back-up bars.
- f) Check the type and size of electrodes to be used for the various joints and positions. Check the storage facilities to see if they are adequate to keep the electrodes dry.
- g) Verify the use of proper pre-heat and interpass temperatures.
- h) Observe the technique of each welder periodically with the use of a welding inspection shield.

2) Nondestructive Testing of Welding:

- a) Welds shall be non-destructive tested by one of the following methods in accordance with AWS D1.1 at the frequency noted below:

Test Method	Frequency
Liquid Dye Penetrant Testing	When requested by Architect.
Magnetic Particle Testing	10% of all fillet welds and 100% of all full penetration welds
Radiographic Testing	When requested by Architect or as substitute for magnetic particles testing or ultrasonic testing.

- b) Reduced Frequency of Testing: Initially, all welds requiring 100% testing shall be tested at the rate of 100% in order to establish the qualifications of each individual welder. If the reject rate is demonstrated to be less than 5% of the welds tested for each welder, then the frequency of testing for that welder may be reduced to 25%. If the reject rate increases to 5% or more, 100% testing shall be re-established until the rate is reduced to less than 5%. The percentage of rejects shall be calculated for each welder independently. A sample of at least 40 completed welds shall be made for such reduction evaluation. Reject rate is defined as the number of welds containing rejectable defects divided by the number of welds completed. For evaluating the reject rate of continuous welds over 3 feet in length, each 12 linear inch increment of welds, one inch or less in thickness, shall be considered one weld. For evaluating the reject rate of continuous welds greater than 2 inch thickness, each 6 linear inches shall be considered one weld.

- F. Remove and replace work where test results indicate that it does not comply with specified requirements.
- G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.7 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

**SECTION 05 50 00**  
**FABRICATED METAL**

**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- A. Provide metals work for hand railing and fencing, guard posts, bearing plates for pumps, and other miscellaneous metal works, complete as indicated, specified and required.
  - 1. Steel channel and/or angle frames and thresholds with anchors
  - 2. Handrails, stairs and grating
  - 3. Pipe supports with saddles, hangers, bracing and attachments as detailed and required, except as provided by other trades
  - 4. Guard post assemblies for removable and stationary types
  - 5. Miscellaneous iron and steel items indicated, specified, or required for completion of the Work, unless included under other Sections of the Specification
  - 6. Miscellaneous connections, anchors, bolts, clips, spacers, nuts, washers, shapes and inserts, as required
  - 7. Galvanizing, shop primer finishes for work of this Section as specified or required, including field touchups.

**1.2 RELATED WORK**

- A. Section 03 15 20 – Anchor Bolts and Post-Installed Anchors
- B. Section 03 30 00 – Cast-In-Place Concrete
- C. Section 09 90 00 – Painting and Coating

**1.3 REFERENCES**

- A. Industry Codes and Standards

American Institute of Steel Construction (AISC)

Specification for the Design, Fabrication and Erection of Steel for Buildings

Code of Standard Practice for Steel Buildings and Bridges

American Society for Testing and Materials (ASTM)

American Welding Society (AWS)

AWS D 1.1            Structural Welding Code Steel

B.    Government Regulations

U.S. Department of Labor, Occupational Safety and Health Administration (OSHA)

Cal/OSHA Standards

1.4    *QUALITY ASSURANCE*

A.    Unless otherwise specified all work specified herein and shown on the Drawings shall conform to the applicable requirements of the following specifications and codes:

1.    Fabricate and erect miscellaneous metal work in accordance with the latest edition of the AISC “Specification for the Design, Fabrication and Erection of Steel for Buildings,” and “Code of Standard Practice for Steel Buildings and Bridges.”
2.    Inspections. Perform all field welding and field high strength bolting of structural steel assemblies under the inspection of the Engineer. Notify the Engineer at least 48 hours in advance of needed inspections. Provide copies of testing and inspection reports to the Engineer.

1.5    *SUBMITTALS*

A.    Submittals shall be in accordance with the General Conditions and Section 01 33 00 – Submittal Procedures.

1.    Shop Drawings and Erection Drawings. Show materials and specification list, construction and fabrication details, layout and erection diagrams and method of anchorage to adjacent construction. Give location, type, size and extent of welding and bolted connections and clearly distinguish between shop and field connections. Coordinate shop drawings with related trades to ensure proper mating of assemblies.
  - a.    Catalog work sheets showing illustrated cuts of item to be furnished, scale details and dimensions may be submitted for standard manufactured items.
  - b.    Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from Drawings. Where concrete, masonry or other materials must be set to exact locations to receive work, furnish assistance and direction necessary to permit other trades to properly locate their work. Where welded connectors, concrete, or masonry inserts are required to receive work, show on shop drawings exact locations required.

2. Shop Painting Data. Submit product list with product data sheets of intended shop coats. These products shall be compatible with the products and manufacturers with those systems Specified in Section 09 90 00 - Painting.

**PART 2 PRODUCTS**

**2.1 MATERIALS – GENERAL**

- A. Provide materials that are new, sound and conforming to the following:

<b>Item</b>	<b>ASTM Standard No.</b>	<b>Class, Grade Type or Alloy No.</b>
<b>Cast Iron</b>		
Cast Iron	A 48	Class 40B
<b>Steel</b>		
Galvanized sheet iron or steel	A 653	Coating G90
Black steel, sheet or strip	A 569 A 570	--
Coil (plate)	A 635	--
Structural plate, bars, rolled shapes, and miscellaneous items (except W shapes)	A 36	--
Rolled W shapes	A 992	Grade 50
Standard bolts, nuts and washers	A 307	--
High strength bolts, nuts and hardened flat washers	A 325 A 490	--
Eyebolts	A 489	Type 1
Tubing, cold-formed	A 500	--
Tubing, hot-formed	A 501	--
Steel pipe	A 53	Grade B
<b>Stainless steel</b>		
Plate, sheet and strip	A 240	Type 304* or 316**
Bars and shapes	A 276	Type 304* or 316**

<b>Aluminum</b>		
Flashing sheet aluminum	B 209	Alloy 5005-H-14, 0.032 inches minimum thickness
Structural sheet aluminum	B 209	Alloy 6061-T6
Structural aluminum	B 209 B 308	Alloy 6061-T6
Extruded aluminum	B 221	Alloy 6063-T42



\*Use Type 304L if material will be welded

\*\*Use Type 316L if material will be welded

1. Anchor bolts:
  - a. Anchorages for all locations unless otherwise indicated on Drawings: Stainless steel, Type 316, Hilti HVA adhesive anchors, or Engineer approved equivalent.
  - b. Chemical bond or adhesive type DBDs, if approved by the manufacturer and the Engineer, are acceptable for anchorage of vibrating machinery or equipment.
2. Expansion Anchors.
  - a. Hilti Kwik-Bolt, Standard Type or Engineer approved equivalent.
3. Galvanizing.
  - a. Iron and Steel. ASTM A123, with average weight per square foot of 2.0 ounces and not less than 1.8 ounces per square foot.
  - b. Ferrous Metal Hardware Items. ASTM A153 with average coating weight of 1.3 ounces per sq. ft.
  - c. Touch-up Material for Galvanized Coatings. Repair galvanized coatings marred or damaged during erection or fabrication by use of DRYGALV as manufactured by the American Solder and Flux Company, Galvalloy, Galvion, Rust-Oleum 7085 Cold Galvanizing Compound, or Engineer approved equivalent.
4. Welding Electrodes. Use welding electrodes conforming to AWS D1.1.
5. Shop Prime Paint. To assure compatibility with deferred field-applied paint or coating systems, for ferrous metals other than stainless steel, galvanized steel and cast iron, provide surface preparations and use shop prime paint product and manufacturer as painting or protective coating system intended for field application specified in Section 09 90 00 - Painting.
  - a. Do not shop prime portions of work immediately adjacent to intended field welds, or portions intended for embedment.

### **PART 3 EXECUTION**

#### **3.1 GENERAL FABRICATION AND INSTALLATION REQUIREMENTS**

- A. Standards: Thoroughly clean ferrous metals of all loose scale and rust before being fabricated. Provide finished members free of twists, bends or open joints, and that present a neat workmanlike appearance when completed. Perform steel work conforming to the best practices set forth in the “Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings” of the American Institute of Steel Construction.
  - 1. Perform aluminum work conforming to the applicable requirements of “Specifications for Aluminum Structures, Aluminum Construction Manual” of the Aluminum Association.
- B. Welding: Perform all welding in accordance with the “Structural Welding Code-Steel,” AWS D1.1.
  - 1. Use only welders qualified by tests in accordance with AWS B 3.0.
- C. General Fabrication and Installation
  - 1. Using new stock of sizes specified or detailed, fabricate in shop producing high grade metal work. Form and fabricate to meet required conditions. Include clips, straps, bolts, screws, and other fastenings necessary to secure the work. Accurately make and tightly fit joining and intersections in true planes with adequate secure fastenings. Erect all metal work plumb, true on line and in its designated location. Grind and finish smooth field welds on exposed surface. Bolt or weld connections as indicated on Drawings. After installation, leave all work in a neat and clean condition, ready for field painting or coating.
    - a. The maximum misalignment tolerance for railing shall be 1/8 inch in 12 feet. Bent, deformed or otherwise damaged railings shall be replaced.
  - 2. Coordinate work of this Section with related trades. Particular attention is required for items to be embedded in concrete work. Provide all punching and drillings indicated or required for attachment of other work to that of this Section.
  - 3. Compliance with Safety Requirements: Dimensions required for the fabrication and installation of handrails, ladders, grating, plate, pipe hangers and etc. which are not shown on the Drawings, shall conform to the requirements of the Division of Occupational Health and Safety.
- D. Protection
  - 1. Provide protection and repair of adjacent surfaces and areas which may become damaged as a result of work of this Section. Protect work performed hereunder until completion and final acceptance of project by the Owner. Repair or replace all damaged or defective work to original specified condition, at no additional cost to the Owner.

E. Painting

1. Apply all products in strict conformance with manufacturer's printed instructions.
2. Provide one or more shop coats of paint on all ferrous metals, except cast-iron, ductile iron, stainless steel and galvanized metals. Before priming, thoroughly clean surfaces. Allow shop coats to dry before materials are loaded for delivery to the job site. After erection, paint all areas where the shop coats have been rubbed off or omitted.
  - a. See Section 09 90 00 - Painting of these specifications for surface preparation, prime coatings, finish painting and coatings.
3. Isolate aluminum members from contact with dissimilar metals, concrete and masonry to provide protection from electrolytic deterioration. Use non-absorptive tape or gaskets, heavy brush coat of approved zinc chromate primer made with a synthetic resin vehicle; or apply a heavy coat of approved alkali-resistant bituminous paint.

**END OF SECTION**

**SECTION 06 16 00**  
**PLYWOOD ROOF SHEATHING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Roof sheathing.

**1.3 DELIVERY, STORAGE, AND HANDLING**

- A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

**PART 2 - PRODUCTS**

**2.1 ROOF SHEATHING**

- A. Plywood Sheathing: Either DOC PS 1 or DOC PS 2, Exposure 1, structural sheathing unless otherwise indicated.
  - 1. Span Rating: As indicated on Drawings.
  - 2. Nominal Thickness: As indicated on Drawings.
- B. Factory mark panels to indicate compliance with applicable standard.

**2.2 FASTENERS**

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
  - 1. Fasteners used for the attachment of exterior wall sheathing, and fasteners in contact with preservative treated or fire retardant treated wood, including nuts and washers, shall be of hot dipped galvanized steel, stainless steel, or silicon bronze; the coating weights for zinc-coated fasteners shall be in accordance with ASTM A 153. The coating weights for mechanically deposited zinc-coated steel

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fasteners shall be in accordance with ASTM B 695, Class 55 minimum. Comply with requirements of 2016 CBC 2304.10.1.1 and 2304.10.5.

- B. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated on Drawings complying with the following:
  - 1. 2016 California Building Code, Table 2304.10.1 "Fastening Schedule."
- D. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.
- G. Comply with applicable recommendations in APA Form No. E30S, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- H. Fastening Methods: Screw roof sheathing panels to metal stud framing. Space panels 1/8 inch apart at edges and ends.

END OF SECTION

## **SECTION 06 64 00**

### **FIBERGLASS REINFORCED PLASTIC PANELING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### **1.2 SUMMARY**

- A. Section includes glass-fiber reinforced plastic (FRP) wall paneling and trim accessories.
- B. Related Sections:
  - 1. Division 09 Section “Gypsum Board.”

##### **1.3 SUBMITTALS**

- A. LEED product Data: For each type of product indicated.
  - 1. Product Data for LEED Credit IEQc4.1 include printed statement of VOC content and chemical components for adhesives and sealants.
- B. Samples for Initial Selection: For plastic paneling and trim accessories.
- C. Samples for Verification: For plastic paneling and trim accessories, in manufacturer's standard sizes.

##### **1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

##### **1.5 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

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## PART 2 - PRODUCTS

### 2.1 FIBERGLASS REINFORCED PLASTIC SHEET PANELING

- A. General: Plastic panels complying with ASTM D 3841 comprised of thermosetting styrenated and acrylated polyester resins reinforced with glass fibers.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Kemlite Company Inc.
    - b. Marlite.
    - c. Nudo Products, Inc.
  2. Nominal Thickness: Not less than 0.09 inch.
  3. Surface Finish: Molded pebble texture.
  4. Color: As selected by Architect from manufacturer's full range of not less than six colors.
  5. Surface-Burning Characteristics: Class C as determined according to ASTM E 84 by UL or another acceptable qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 76-200.
    - b. Smoke-Developed Index: 450 or less.

### 2.2 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
1. Color: Match panels.
- B. Adhesive: As recommended by plastic paneling manufacturer.
1. VOC Content: 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Sealant: Single-component, mildew-resistant, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Division 07 Section "Joint Sealants."
1. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove wall coverings, loose or soluble paint, and other materials that might interfere with adhesive bond.
- B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- C. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.
- D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.
  - 1. Mark plumb lines on substrate at trim accessory or panel joint locations for accurate installation.
  - 2. Locate trim accessories and panel joints to allow clearance at panel edges according to manufacturer's written instructions.

### 3.3 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels at locations indicated with vertical edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
  - 1. Install panels vertically without horizontal joints unless distance is greater than the maximum available panel length. Where horizontal joints cannot be avoided, provide H-shaped trim between panels.
- C. Install panels in a full spread of adhesive.
- D. Install trim accessories with adhesive.



- E. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.
- F. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- G. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

### 3.4 CLEANING

- A. Clean panel faces to remove soiling, stains, dust, and dirt using clean rags and cleaning agents as instructed by panel manufacturer.

END OF SECTION

**SECTION 07 21 00**  
**THERMAL INSULATION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Glass fiber blanket insulation in walls and ceilings.
- B. Related Sections include the following:
  - 1. Division 05 Section “Cold-formed Metal Framing” for exterior stud wall framing.
  - 2. Division 07 Section “Insulation System for Metal Buildings” for insulation of Administration building roof.
  - 3. Division 09 Section “Non-structural Metal Framing” for interior metal stud wall and ceiling framing.
  - 4. Division 22 Section “Plumbing” for insulation related to piping.
  - 5. Division 23 Section “HVAC” for insulation related to air distribution ducts.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.

**1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with

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manufacturer's written instructions for handling, storing, and protecting during installation.

## PART 2 - PRODUCTS

### 2.1 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
1. CertainTeed Corporation.
  2. Guardian Fiberglass, Inc.
  3. Johns Manville.
  4. Knauf Fiber Glass.
  5. Owens Corning.
- B. Reinforced-Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
- C. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- D. Where glass-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt or roll form with thermal resistances indicated:
1. R11: 3-1/2 inches thick with a thermal resistance of 11 deg F x h x sq. ft./Btu at 75 deg F.
  2. R19: 6-1/2 inches thick with a thermal resistance of 19 deg F x h x sq. ft./Btu at 75 deg F.
  3. R21: 5-1/2 inches thick with a thermal resistance of 21 deg F x h x sq. ft./Btu at 75 deg F.

### 2.2 ACCESSORY MATERIALS

- A. Accessory materials shall be as recommended in writing by insulation manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

### 3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire air-conditioned building area. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.
- E. Install thermal insulation to provide a complete thermal envelope of conditioned spaces.

### 3.4 INSTALLATION OF BLANKET INSULATION

- A. Glass-Fiber Blanket Insulation: Install in wall cavities formed by framing members according to the following requirements:
  - 1. Use preformed insulating units of sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply in single layer of thickness required.

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- a. Use insulation of widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  - b. Thickness of insulation shall not be less than the depth of framing members unless indicated otherwise on the Drawings.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  3. For metal-framed wall cavities where cavity heights exceed 96 inches, support faced blankets by taping flanges of insulation to flanges of metal studs.
  4. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation. Set units with facings toward conditioned side of spaces.
  5. Install foil-faced batts in exterior walls with foil facing interior of building. Install unfaced batts at interior walls to improve acoustic performance.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
  2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

### 3.5 PROTECTION

- A. Protect installed insulation and facings from damage due to harmful weather exposures, moisture, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

## SECTION 07 26 16

### UNDERSLAB VAPOR RETARDER

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Under slab vapor barrier for concrete slabs on grade.
- B. Related Sections include but are not limited to the following:
  - 1. Division 03 Section "Cast-in-Place Concrete."

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, include manufacturer's specifications and installation instructions.
- B. Samples: For vapor barrier membrane.
- C. Digital Photography: Digital photographs of completed installation including seam and penetration sealing, terminations at foundations, and repairs.

##### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain vapor barrier materials through one source from a single manufacturer.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened packaging, with labels identifying manufacturer and product.
- B. Store materials in accordance with manufacturer's written instructions and to prevent damage.

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- C. Protect stored materials from direct sunlight.

#### 1.6 PROJECT CONDITIONS

- A. Do not apply material during rain or during windy conditions.
- B. Do not apply on frozen ground.

#### 1.7 COORDINATION

- A. Coordinate installation of vapor barrier, reinforcing steel, and pouring of concrete slabs to minimize exposure of vapor barrier to sunlight.
- B. Coordinate installation of vapor barrier with reinforcing steel to minimize tears and punctures.

### PART 2 - PRODUCTS

#### 2.1 VAPOR BARRIERS

- A. Plastic Vapor Barrier: Single ply membrane extruded from virgin grade high-impact polyolefin complying with ASTM E 1745, Class A.
  - 1. Available Products: Subject to compliance with requirements, provide one of the following products:
    - a. Fortifiber Building Systems Group; Moistop Ultra 15
    - b. Insulation Solutions Inc.; Viper I.
    - c. Raven Industries Inc.; Vapor Block 15.
    - d. Stego Industries; Stego Wrap Vapor Barrier
    - e. W.R. Meadows, Inc., Perminator 15.
  - 2. Thickness: 15 mils, minimum.
  - 3. Roll Width: 12 feet minimum.
  - 4. Maximum Permeance: ASTM E96 new material 0.010 Perms; ASTM E154 Section 11 after weathering 0.010.
  - 5. Puncture Resistance: ASTM D1709, Method B, not less than 3,000 Grams.

#### 2.2 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by manufacturer for intended use and compatible with vapor barrier.

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- B. Seam Tape: High Density Polyethylene Tape with pressure sensitive adhesive as manufactured or recommended by vapor barrier manufacturer, minimum width 4 inches.
- C. Pipe Boots: Construct pipe boots from vapor barrier material and pressure sensitive tape per manufacturer's written installation instructions.
- D. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine conditions with Installer present for compliance with requirements for conditions affecting performance of the Work.
- B. Proceed with installation of vapor barrier only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Level and tamp or roll granular base as specified in Division 31 Section "Earthwork."

#### 3.3 INSTALLATION OF VAPOR BARRIER

- A. Vapor Barriers: Place, protect, and repair vapor barrier according to ASTM E 1643 and manufacturer's written instructions.
  - 1. Vapor barrier to be installed over prepared, finely graded subgrade.
- B. Unroll vapor barrier and install with the longest dimension parallel with the direction of the pour. Open all folds to the full width.
- C. Lap joints 6 inches and seal with manufacturer's recommended tape.
- D. Seal holes, openings, and pipe and conduit penetrations in vapor barrier. Fabricate boots around pipes and conduits in accordance with manufacturer's written installation instructions and seal with tape.
- E. Areas of adhesion for taped seams, penetrations, and repairs shall be free of dust, dirt, moisture, or other conditions affecting the performance of the tape seal.
- F. Terminate vapor barrier at vertical foundation walls by turning up 4 inches against the wall and sealing with tape or fastening with concrete nails spaced 4 feet on center. Where vertical foundation walls do not occur, extend vapor barrier not less than 12 inches into footing trench prior to pouring footings.

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- G. Place 2 inches of dry sand over properly installed and inspected vapor barrier. Protect from rain and moisture; remove sand that is saturated or dampened prior to concrete placement.
- H. Coordinate installation of vapor barrier with Work Division 3 Section “Cast-in-Place Concrete.”
  - 1. Use only brick type reinforcing bar supports for reinforcing steel.
  - 2. Avoid driving stakes through vapor barrier membrane, repair all holes.
  - 3. Provide for protection of vapor barrier membrane in high traffic areas.

### 3.4 FIELD QUALITY CONTROL

- A. Immediately after the installation of the vapor barrier, the Contractor, in the presence of the Owner’s Inspector or representative, shall review the completed installation and document the installation using digital photography. Documentation shall include the completed installation, seams, penetrations, terminations, and repairs.
- B. After installation of reinforcing steel and just prior to pouring of concrete, the Contractor, in the presence of the Owner’s Inspector or representative, shall review the installed vapor barrier for tears or damage.
- C. Inspection reports shall be submitted to the Owner, Architect and the Contractor.

### 3.5 REPAIRS

- A. Repair tears and punctures with a vapor barrier patch that overlaps the damaged area by 6 inches in all directions, seal perimeter of the patch with tape.

### 3.6 PROTECTION

- A. Protect installed vapor barriers from damage due to UV light, harmful weather exposures, physical abuse, and other causes until concealed by permanent construction.
- B. Remove rain or water from barrier prior to concrete placement by air blowers.

END OF SECTION

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## **SECTION 07 41 12**

### **METAL ROOF AND WALL PANELS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### **1.2 SUMMARY**

- A. Section Includes:

- 1. Exposed-fastener, lap-seam metal wall panels.
  - 2. Standing-seam metal roof panels (Lock seam).

- B. Related Sections:

- 1. Division 05 Section "Cold Formed Metal Framing" for framing supporting metal roof panels.
  - 2. Division 06 Section "Sheathing" for plywood roof sheathing substrate.
  - 3. Division 07 Section "Sheet Metal Flashing and Trim" for sheet metal work that is not part of metal roof and wall panel assemblies.
  - 4. Division 07 Section "Joint Sealants" for field-applied sealants not otherwise specified in this Section.

##### **1.3 DEFINITIONS**

- A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weather tight roofing system.
- B. Metal Wall Panel Assembly: Metal wall panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weather tight wall system.

##### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of roof panel and accessory.

- B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, side-seam and endlap joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.
- C. Samples for Initial Selection: For each type of metal roof panel indicated with factory-applied color finishes.
  - 1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
  - 1. Metal Roof and Wall Panels: 8 inch square sample for each color selected on same material of panels.
- E. Qualification Data: For qualified Installer.
- F. Maintenance Data: For metal roof panels to include in maintenance manuals.
- G. Warranties: Samples of special warranties.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain each type of metal roof panels from single source from single manufacturer.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Protect strippable protective covering on metal panels from exposure to sunlight and high humidity, except to extent necessary for period of metal panel installation.

## 1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit metal roof panel work to be performed according to manufacturer's written instructions and warranty requirements.
- B. Field Measurements: Verify actual dimensions of construction contiguous with metal panels by field measurements before fabrication.

## 1.8 COORDINATION

- A. Coordinate metal panels with rain drainage work, flashing, trim, and construction of adjoining work to provide a leakproof, secure, and noncorrosive installation.

## 1.9 WARRANTY

- A. Special Warranty, Panel Substrate Material: Manufacturer's standard form in which manufacturer agrees to repair or replace metal roof or wall panel assemblies that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Warranty, Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- C. Special Warranty, Weathertightness for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Roof Panel Requirements:
  1. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:
    - a. Three-year, aged solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
    - b. Three-year, aged Solar Reflectance Index of not less than 64 when calculated according to ASTM E 1980.
  2. Air Infiltration, Roof Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of roof area when tested according to ASTM E 1680 at the following test-pressure difference:
    - a. Test-Pressure Difference: 6.24 lbf/sq. ft., static air pressure difference.
  3. Water Penetration, Roof Panels: No uncontrolled water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
    - a. Test-Pressure Difference: 6.4 lbf/sq. ft., static pressure.
  4. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with ASTM E 1592 and UL 580 for wind-uplift-resistance class indicated.
    - a. Uplift Rating: UL 90.
- C. Wall Panel Requirements:
  1. Air Infiltration, Wall Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of area when tested according to ASTM E 283 at the following test-pressure difference:
    - a. Test-Pressure Difference: 6.24 lbf/sq. ft., positive pressure.
  2. Water Penetration, Wall Panels: No uncontrolled water penetration when tested according to ASTM E 331 at the following test-pressure difference:
    - a. Test-Pressure Difference: 6.24 lbf/sq. ft., positive pressure.

D. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes as follows:

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 PANEL MATERIALS

A. Metallic-Coated Steel Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Aluminum-Zinc Alloy-Coated Steel Sheet (Galvalume): ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; structural quality.
2. Exposed Coil-Coated Finish: 2-Coat Fluoropolymer (Kynar 500) finish, AAMA 621, containing not less than 70 percent PVDF resin by weight in color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.3 Manufacturer, Basis of Design: Design, Drawings, and Specifications are based on designated metal roof and wall panels manufactured by the following:

1. Metal Sales Manufacturing Corporation.
  - a. Subject to compliance with requirements, provide products indicated or equivalent products by one of the following:
    - 1) ASC Profiles/AEP Span.
    - 2) Centria.
    - 3) Metal Building Components Inc. (MBCI).
    - 4) McElroy Metal

## 2.4 STANDING-SEAM METAL ROOF PANELS

A. Metal Roof Panels: Vertical-rib, snap-joint, standing-seam metal roof panels formed with vertical ribs at panel edges and intermediate stiffening ribs (striations) symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
- B. Basis-of-Design Product: Drawings and specifications are based on the following:
  1. Metal Sales Corporation; Vertical Seam roof panel (12 inch) System.
- C. Physical Properties:
  1. Panel Profile: Flat panel with striations.
  2. Panel Coverage: 12 inches.
  3. Panel Height: 1-3/4 inch.
  4. Material Thickness: 0.028 inch (24 gage).
  5. Surface: Smooth.
  6. Color: As selected by Architect from manufacturer's full range.
- D. Clips: Manufacturer's standard clips to accommodate thermal movement of panels.

## 2.5 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. Metal Wall Panels: Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
- B. Basis-of-Design Product: Drawings and specifications are based on the following:
  1. Metal Sales Corporation; PBR-Panel.
- C. Physical Properties:
  1. Panel Profile: Tapered rib profile formed with raised trapezoidal major ribs spaced 12 inches on center and two intermediate stiffening ribs between major ribs.
  2. Panel Coverage: 36 inches.
  3. Panel Depth: 1-1/4 inch.
  4. Material Thickness: 0.028 inch (24 gage).
  5. Surface: Smooth.
  6. Color: As selected by Architect from manufacturer's full range.

## 2.6 FLASHING AND TRIM

- A. Flashing and Trim: Formed from same material, thickness, finish, and color as panels. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.

- B. Gutters: Formed from same material roof panels. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.
- C. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual". Finish downspouts to match gutters.

## 2.7 UNDERLAYMENT FOR METAL ROOF PANELS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
  - 1. Basis of Design: Design, Drawings, and Specifications are based on the following:
    - a. GCP Applied Technologies Inc.; Ultra  
(GPC was formerly Grace Construction Products and W.R. Grace).
      - 1) Subject to compliance with requirements, provide product indicated or a comparable product by one of the following:
        - a) Carlisle Coatings & Waterproofing Inc., Div. of Carlisle Companies Inc.; CCW WIP 300HT.
        - b) Henry Company; Blueskin PE200 HT.
        - c) Metal-Fab Manufacturing, LLC; MetShield.
        - d) Owens Corning; WeatherLock Metal High Temperature Underlayment.
    - b. Source Limitations: Obtain each type of metal roof panels from single source from single manufacturer.
  - 2. Physical Properties and Characteristics:
    - a. Color: Gray-black.
    - b. Membrane Thickness: 30 mil minimum, ASTM D3767 method A.
    - c. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
    - d. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
    - e. Tensile strength, Membrane: 250 psi, ASTM D412 (Die C modified).
    - f. Elongation, Membrane: 250% ASTM D412 (Die C modified).



- g. Adhesion to Plywood: 3.0 lbs/in width, ASTM D903.
- h. Permeance (max): 0.05 Perms, ASTM E96.
- i. Material Weight Installed (max): 0.22 lb/ft<sup>2</sup>, ASTM D461.
- j. Service Temperature: 300 degrees F per ASTM D1204.

## 2.8 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.
- C. Anchor Clips: Manufacturer's standard concealed anchor clips fabricated from 14 gage G90 galvanized steel.
- D. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
  - 2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal roof panels and remain weathertight; and as recommended in writing by metal roof panel manufacturer.
  - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

## 2.9 ACCESSORIES

- A. Panel Accessories: Provide components approved by panel manufacturer and as required for a complete assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
  - 2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

3. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  
- B. Roof Curbs: Fabricated from same material as roof panels, minimum 0.048 inch thick; with bottom of skirt profiled to match roof panel profiles, and welded top box and integral full-length cricket. Fabricate curb subframing of minimum 0.0598-inch thick, angle, C, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads, of size and height indicated. Finish roof curbs to match metal roof panels.

## 2.10 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal roof panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weathertight and minimize noise from movements within panel assembly.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
  1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  2. End Seams for Coil Coated Finished Material: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  3. End Seams for Field Finished Material: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
  5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  6. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA's "Architectural Sheet Metal Manual" or by metal roof panel manufacturer for application, but not less than thickness of metal being secured.

## 2.11 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
  - 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the Work.
- B. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
- C. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 UNDERLAYMENT INSTALLATION

- A. General: Install products in accordance with manufacturer's written installation instructions.
- B. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply over

the entire metal panel roof surface area, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.

1. Do not install underlayment on wet or frozen substrates.
2. Install when surface temperature of substrate is a minimum of 40 degrees F (5 degrees C) and rising.
3. Remove dust, dirt, loose materials and protrusions from deck surface.
4. Install membrane on clean, dry, continuous substrate deck. Fill voids and damaged or unsupported areas prior to installation.
5. Install membrane such that all laps shed water. Work from the low point to the high point of the roof at all times. Apply the membrane in valleys before the membrane is applied to the eaves. Following placement along the eaves, continue application of the membrane up the roof. Membrane may be installed either vertically or horizontally after the first horizontal course.
6. Side laps minimum 3-1/2 inches and end laps minimum 6 inches following lap lines marked on underlayment.
7. Patch penetrations and damage using manufacturer's recommended methods.

### 3.3 METAL ROOF PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Shim or otherwise plumb substrates receiving metal panels.
  2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  3. Install screw fasteners in predrilled holes.
  4. Locate and space fastenings in uniform vertical and horizontal alignment.
  5. Install flashing and trim as metal panel work proceeds.
  6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners, Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
  - 1. Install clips to supports with self-tapping fasteners.
  - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
  - 3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
  - 4. Watertight Installation:
    - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
    - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
- F. Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.

### 3.4 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Commence metal wall panel installation and install minimum of 300 sq. ft. in presence of factory-authorized representative if required for warranty.
  - 2. Shim or otherwise plumb substrates receiving metal wall panels.
  - 3. Flash and seal metal wall panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until weather barrier and flashings that will be concealed by metal wall panels are installed.
  - 4. Install screw fasteners in predrilled holes.
  - 5. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 6. Install flashing and trim as metal wall panel work proceeds.
  - 7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  - 8. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
  - 9. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.

10. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.
- B. Lap-Seam Metal Wall Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
  2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
  3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
  4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
  5. Flash and seal panels with weather closures at perimeter of all openings.
- C. Watertight Installation:
1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
  2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
  3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- D. Fasteners: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized steel fasteners for surfaces exposed to the interior.
- E. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal wall panel manufacturer.

### 3.5 FLASHING, TRIM, AND ACCESSORY INSTALLATION

- A. General: Install flashing, trim, and accessories with positive anchorage to building, with weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated.

Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
  2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
- E. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.
- F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

### 3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect metal roof and wall panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal panels where inspections indicate that they do not comply with specified requirements.
- C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.7 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION



## SECTION 07 62 00

### SHEET METAL FLASHING AND TRIM

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

##### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Formed Sheet Metal Flashing Products:
    - a. Formed sheet metal flashing and trim.
- B. Related Sections include the following:
  - 1. Division 07 Sections as applicable to metal roof and wall panels for installation of sheet metal flashing and trim integral with roof and wall panel systems.
  - 2. Division 07 Section "Joint Sealants" for field-applied sheet metal flashing and trim sealants.
  - 3. Division 13 Section "Metal Building Systems" for installation of sheet metal integral with metal building roof and wall panel systems.

##### 1.3 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Thermal Movements: Sheet metal flashing and trim shall allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements.
  - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop and field-assembled work. Include the following:
  - 1. Identification of material, thickness, weight, and finish for each item and location in Project.
  - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
  - 3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
  - 4. Details of termination points and assemblies, including fixed points.
  - 5. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
  - 6. Details of special conditions.
  - 7. Details of connections to adjoining work.
  - 8. Detail formed flashing and trim at a scale of not less than 3 inches per 12 inches.
- C. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.

#### 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" and NRCA's Roofing and Waterproofing Manuals as applicable to project conditions. Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- C. Preinstallation Conference: Conduct conference at Project site.
  - 1. Meet with Owner, Architect, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
  - 2. Review methods and procedures related to sheet metal flashing and trim.
  - 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
  - 4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

## 1.7 COORDINATION

- A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

## PART 2 - PRODUCTS

### 2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
  - 1. Color: As selected by Architect from manufacturer's full range.
- B. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
  - 1. Surface: Smooth, flat and mill phosphatized for field painting.
  - 2. Color: As selected by Architect from manufacturer's full range.

### 2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
  - 1. Self-drilling screws, gasketed, with hex-washer head.
  - 2. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
  - 3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.

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- C. Solder for Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane, polysulfide, or silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

### 2.3 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim as indicated on Drawings and to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
  - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
  - 2. Obtain field measurements for accurate fit before shop fabrication.
  - 3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
  - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored and of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.

- F. Seams: Fabricate nonmoving seams with flat-lock seams and as follows:
  - 1. Seams for Pre-Finished Metal: Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
  - 2. Seams for Unfinished Sheet Steel: Tin edges to be seamed, form seams, and solder.
- G. Do not use graphite pencils to mark metal surfaces.
- H. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

## 2.4 SHEET METAL FABRICATIONS

- A. Column to Chain Link Post Closure: Fabricate from 0.064 inch (16 gage) thick galvanized steel.

## 2.5 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Miscellaneous Sheet Metal Fabrications: Fabricate from 0.028 inch (24 gage) thick galvanized steel unless otherwise indicated.

## 2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
  - 1. Verify compliance with requirements for installation tolerances of substrates.

2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
  2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
  4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
  5. Install sealant tape where indicated.
  6. Torch cutting of sheet metal flashing and trim is not permitted.
  7. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corners or intersections. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- D. Fastener Sizes:
1. Metal Framing, Backing, and Decking: Use fasteners of sizes that will penetrate metal framing, backing, and decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder coil-coated steel and aluminum sheet.
  2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

### 3.3 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

### 3.4 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### 3.5 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

## **SECTION 07 92 00**

### **JOINT SEALANTS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

##### **1.2 SUMMARY**

- A. Section includes the following:

- 1. Product Types:
  - a. Silicone joint sealants.
  - b. Urethane joint sealants.
  - c. Latex joint sealants.
  - d. Acoustic sealants.
  - e. Backing material.
- 2. Joint Types:
  - a. Interior and exterior joints between dissimilar materials.
  - b. Flashing joints.

- B. Related Sections include the following:

- 1. Division 08 Section "Glazing" for glazing sealants.
- 2. Division 13 Section "Metal Building Systems" for sealants related to exterior roof and wall panels.
- 3. Division 22 Specification Sections for sealants related to plumbing work.
- 4. Division 23 Specification Sections for sealants related to mechanical work.
- 5. Division 26 Specification Sections for sealants related to electrical work.

##### **1.3 DEFINITIONS**

- A. "Caulking " applies only to materials and work in connection with the filling or closing of interior joints where expansion or contraction are of no consideration and where filling and closing of these interior joints is primarily for appearance and cleanliness.
- B. "Sealant" applies to materials and work to seal and make watertight all joints on the exterior of the building and joints on the interior of the building that may be expected to expand and contract or are subject to water or dampness.
- C. "Joints" applies to gaps, cracks, or separations of any kind in or between materials, assemblies or units.



- D. “Weather Tight” applies to materials which have been sealed to prevent leakage of air, light, or water into building interiors.

#### 1.4 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Warranties: Sample of special warranties.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of not less than 5 years of successful in-service performance.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Use and designation of Sealant or Caulking to be in conformance with ASTM C 1193 – Standard Guide for use of Joint Sealants.
- D. Shelf Life: Do not use materials whose shelf life has expired.

#### 1.6 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
  - 2. When joint substrates are wet.
  - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS, GENERAL

- A. Listed manufacturers are to identify the functional characteristics of sealant / caulking material. Alternate manufacturers may be considered by the Architect prior to bid.
- B. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and

application, as demonstrated by sealant manufacturer based on testing and field experience.

- C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- D. Stain-Test-Response Characteristics: Sealants for porous materials shall have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- E. Colors of Exposed Joint Sealants: Black at building exterior, white at interior.

## 2.2 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
  - 1. Location of Use: Exterior locations where both joint faces are metal, glass, plastic, or other non-porous material.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) G.E. 1200 Sealant.
      - 2) Dow Corning 999-A Sealant.
- B. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
  - 1. Location of Use: Interior locations between plumbing fixtures and floor or wall surfaces of non-porous materials.
    - a. Products: Subject to compliance with requirements, provide the following:
      - 1) Dow Corning Corporation; 786 Mildew Resistant.
      - 2) GE Advanced Materials - Silicones; Sanitary SCS1700.

## 2.3 URETHANE JOINT SEALANTS

- A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
  - 1. Location of Use: Interior and exterior joints requiring painting.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) BASF Building Systems; Sonolastic NP1.
      - 2) Pecora Corporation; Dynatrol I-XL.
      - 3) Sika Corporation, Construction Products Division; Sikaflex - 1a.

## 2.4 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: General purpose, paintable, acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
  - 1. Location of Use: Interior non-moving joints between gypsum board and adjacent materials or surfaces.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) BASF Building Systems; Sonolac.
      - 2) Pecora Corporation; AC-20+.
      - 3) Tremco Incorporated; Tremflex 834.

## 2.5 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  - 1. Location of Use: Interior joints where indicated.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Pecora Corporation; AC-20 FTR.
      - 2) USG Corporation; SHEETROCK Acoustical Sealant.

## 2.6 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Sealant Backings: Cellular foam sealant backings complying with ASTM C 1330, Type C (closed-cell material with a surface skin) or Type B (bicellular material with a surface skin) and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
  - 1. Closed-Cell Synthetic Rubber Joint Filler: Provide expanded synthetic rubber complying with ASTM D 1056, Class SC-E (oil-resistant and medium swell), of 2 to 5 psi compression deflection (Grade SCE 41).
  - 2. Closed-Cell PVC Joint Filler: Provide flexible expanded polyvinyl chloride complying with ASTM D 1667, Grade VE 41 BL (3.0 psi compression deflection); except provide higher compression deflection grades as may be necessary to withstand installation forces and provide proper support for sealants, if any.
  - 3. Closed-Cell Semi-Rigid Plastic Joint Filler: Provide semi-rigid, compressible, nonstaining closed-cell plastic joint filler, recommended by manufacturer where low modulus of elasticity is required, but suitable for retaining poured concrete.
  - 4. Expanded Polyethylene Joint Filler: Provide flexible, compressible, closed-cell, polyethylene of not less than 10 psi compression deflection (25%); except

provide higher compression deflection strength as may be necessary to withstand installation forces and provide proper support for sealants; surface water absorption of not more than 0.1 lbs. per sq. ft.

- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.7 MISCELLANEOUS MATERIALS

- A. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- B. Joint Primer/Sealer: Provide type of joint primer/sealer recommended by sealant manufacturer for joint surfaces to be primed or sealed.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.

3. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
  4. Remove laitance and form-release agents from concrete.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
  2. Do not stretch, twist, puncture, or tear sealant backings.
  3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants at the same time as backings, using proven techniques that comply with the following:
1. Place sealants in uniform, continuous ribbons without gaps or air pockets, and so they directly contact and fully wet joint substrates.
  2. Completely fill recesses in each joint configuration.
  3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
  2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
- G. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.
- H. Install sealant to depths as shown or, if not shown, as recommended by sealant manufacturer but within the following general limitations, measured at center (thin) section of bead:
1. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50% of joint width, but neither more than 1/2" deep nor less than 1/4" deep.
  2. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints to a depth in range of 75% to 125% of joint width.
- I. Recess exposed edges of exposed joint fillers slightly behind adjoining surfaces, unless otherwise shown, so that compressed units will not protrude from joints.

### 3.4 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur. Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces.

### 3.5 PROTECTION

- A. Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.
- B. Repair or cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

## SECTION 08 11 13

### HOLLOW METAL DOORS AND FRAMES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Hollow-metal steel door and window frames.
  - 2. Hollow-metal steel doors.
- B. Related Sections:
  - 1. Division 08 Section "Door Hardware" for hollow metal door hardware.
  - 2. Division 08 Section "Glazing" for glass installed in hollow metal doors and frames.
  - 3. Division 09 Sections "Painting" for field painting of hollow metal doors and frames.

##### 1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.

##### 1.4 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, and finishes for each type of steel door and frame specified.
- B. Shop Drawings: In addition to requirements below, provide a schedule of standard steel doors and frames using same reference numbers for details and openings as those on Drawings:
  - 1. Frame details for each frame type, including dimensioned profiles.
  - 2. Door details for each door with locations of reinforcement and preparation for hardware.
  - 3. Details and locations of reinforcement and preparations for hardware.

4. Details of each different wall opening condition.
5. Details of anchorages, accessories, joints, and connections.

- C. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store doors and frames under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.
  2. If wrappers on doors become wet, remove cartons immediately.

#### 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication and indicate measurements on Shop Drawings.
1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating steel frames without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

#### 1.8 COORDINATION

- A. Coordinate installation of anchorages for standard steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete. Deliver such items to Project site in time for installation.



## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amweld Building Products, LLC.
  2. Ceco Door Products; an Assa Abloy Group company.
  3. Curries Company; an Assa Abloy Group company.
  4. Deansteel Manufacturing Company, Inc.
  5. Republic Doors & Frames.
  6. Steelcraft; an Ingersoll-Rand company.

### 2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 zinc-iron-alloy coating designation.
- D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: For items to be built into exterior walls provide hot-dip galvanized according to ASTM A 153/A 153M.
- F. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type non-corrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- G. Glazing: Comply with requirements in Division 8 Section "Glazing."

## 2.3 HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
1. Design: Flush panel.
  2. Core Construction:
    - a. Exterior Doors: Manufacturer's standard polyurethane, or polyisocyanurate core with minimum 14.8 R Value.
    - b. Interior Doors: One inch cell kraft honeycomb phenolic resin impregnated core laminated to face sheets full area, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion..
  3. Door Thickness: 1-3/4 inches unless otherwise indicated
  4. Vertical Edges for Single-Acting Doors: Beveled, 1/8 inch in 2 inches.
  5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch thick, end closures or channels of same material as face sheets.
  6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 2 and Physical Performance Level B (Heavy Duty, 16 gage), Model 1 (Full Flush).
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 2 and Physical Performance Level B (Heavy Duty, 18 gage), Model 1 (Full Flush).
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

## 2.4 STEEL FRAMES

- A. General: Comply with ANSI A250.8 and with details indicated for type and profile.
- B. Fabricate frames with mitered or coped and full profile welded corners.

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- C. Frames shall be sized to provide full throat width equal to depth of wall including finishes plus 1/2 inch backbend on each side per SDI-100.
- D. Exterior Frames: Fabricate from metallic-coated steel sheet.
  - 1. Frames for Level 2 and 3 Steel Doors: 0.053-inch thick (16 gage) steel sheet.
- E. Interior Frames: Fabricate from 0.042-inch (18 gage) thick cold-rolled steel sheet.
- F. Hardware Reinforcement: Fabricate with reinforcement plates from same material as frames with minimum reinforcement according to ANSI/SDI A250.6 and the following:
  - 1. Hinges: Minimum 0.123 inch thick by 1-1/2 inches wide by full length of door (for continuous hinge), secured by not less than 6 spot welds.
  - 2. Lock Face, Closers, and Concealed Holders: Minimum 0.067 inch thick.
  - 3. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick.
- G. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.
- H. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

## 2.5 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
  - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

## 2.6 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with standard steel frames, minimum 5/8 inch high, unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

## 2.7 FABRICATION

- A. General: Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:
1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
  2. Glazed Lites: Factory cut openings in doors.
  3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
  2. Provide countersunk, flat or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
  4. Jamb Anchors: Provide number and spacing of anchors as follows unless additional anchors are required for fire rating:
    - a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - 1) Four anchors per jamb from 60 to 90 inches high.
      - 2) Five anchors per jamb from 90 to 96 inches high.
      - 3) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
      - 4) Two anchors per head for frames 42 inches or more in width and mounted in metal-stud partitions.
  5. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

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- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
  - 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
  - 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
  - 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
  - 1. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  - 2. Provide loose stops and moldings on inside of hollow metal work.
  - 3. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

## 2.8 STEEL FINISHES

- A. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils.
  - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation and with installation spreaders in place, adjust and securely brace frames for squareness, alignment, twist, and plumbness to the following tolerances:
  1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
  3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a plumb line from head to floor.
- C. Drill and tap doors and frames to receive non-templated mortised and surface-mounted door hardware.

### 3.3 INSTALLATION

- A. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install frames of size and profile indicated. Comply with ANSI/SDI A250.11.
  1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. Install frames with removable glazing stops located on secure side of opening.
    - b. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - c. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
  2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
  3. Stud Partitions: Solidly pack mineral-fiber insulation behind frames.

4. Installation Tolerances: Adjust door frames for squareness, alignment, twist, and plumb to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
  - C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
    1. Non-Fire-Rated Standard Steel Doors:
      - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
      - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
      - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
      - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
  - D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
    1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.
- 3.4 ADJUSTING AND CLEANING
- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames that are warped, bowed, or otherwise unacceptable.
  - B. Remove grout and other bonding material from doors and frames immediately after installation.
  - C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
  - D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

## **SECTION 08 71 00**

### **DOOR HARDWARE**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions of Division 01 Specification Sections, apply to this Section.

##### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Commercial door hardware for swinging doors.
- B. Related Sections include but are not limited to the following:
  - 1. Division 08 Section "Hollow Metal Doors and Frames."

##### **1.3 REFERENCES AND ABBREVIATIONS**

- A. Industry standard references and abbreviations shall be as follows:
  - 1. ADA: Americans with Disabilities Act (ADA), 2010 ADA Standards for Accessible Design.
  - 2. BHMA: Builders' Hardware Manufacturers Association.
  - 3. CCR: California Code of Regulations, Title 24, Part 2, California Building Code.
  - 4. DHI: Door and Hardware Institute.
  - 5. NFPA: National Fire Protection Association.
    - a. NFPA 80: Fire Doors and Windows.
    - b. NFPA 101: Life Safety Code.
    - c. NFPA 105: Smoke and Draft Control Door Assemblies
    - d. NFPA 252: Fire Tests of Door Assemblies.
  - 6. UL - Underwriters Laboratories.
    - a. UL 10C: Positive Pressure Fire Tests of Door Assemblies.
    - b. UL 305: Panic Hardware.
  - 7. WHI: Warnock Hersey Incorporated.
  - 8. SDI: Steel Door Institute.
  - 9. NAAMM: National Association of Architectural Metal Manufacturers.



#### 1.4 SUBSTITUTIONS

- A. Substitutions: Substitutions will only be allowed by substitution requests submitted in accordance with Division 01 Section “Substitution Procedures” prior to the bid date.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule. Organize schedule vertically into “Hardware Sets” with index of doors and headings, indicating complete designations of every item required for each door or opening. Include the following information:
1. Type, style, function, size and finish of each hardware item.
  2. Name, part number and manufacturer of each item.
  3. Fastenings and other pertinent information.
  4. Location of hardware set coordinated with floor plans and door schedule.
  5. Explanation of all abbreviations, symbols and codes contained in schedule.
  6. Mounting locations for hardware.
  7. Door and frame sizes and materials.
  8. List of manufacturers used and their nearest representative with address and phone number.
  9. Keying information.
  10. Manufacturer’s catalog cut sheets.
- C. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include “as installed” final hardware and keying schedule.
- D. As-Built Schedule: As-built/as-installed schedule with closeout documents, including keying schedule, wiring diagrams, manufacturers’ installation, adjustment and maintenance information, and supplier’s final inspection report.
- E. Warranty: Special warranty specified in this Section.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in the installation of commercial door hardware with five years documented experience.

- B. Supplier Qualifications: A recognized architectural door hardware supplier with warehousing facilities in the Project's vicinity that has a record of successful in-service performance for supplying door hardware that is similar in quantity, type, and quality to that specified for this Project, and who employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.
  - 1. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.
    - a. Architectural Hardware Consultant Responsibilities:
      - 1) Detailing, scheduling and ordering of finish hardware.
      - 2) Meeting with Owner to finalize keying requirements and to obtain final instructions in writing.
      - 3) Stock parts for products supplied and be capable of repairing and replacing hardware items found defective within warranty periods.
- C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
- D. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.
- E. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Conference participants shall include Owner's lock system representative, Supplier's Architectural Hardware Consultant Contractor, and Architect. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system.

#### 1.7 DELIVERY, STORAGE AND HANDLING

- A. Coordinate delivery of packaged hardware items to the appropriate locations (shop or field) for installation.
- B. Hardware items shall be individually packaged in manufacturers' original containers, complete with proper fasteners. Clearly mark packages on outside to indicate contents and locations in hardware schedule and in work.
- C. Provide locked storage area for hardware, protect from moisture, sunlight, paint, and chemicals.
- D. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.
- E. Deliver permanent keys and cores directly from lock manufacturer to Owner's designated representative by secured delivery.

## 1.8 COORDINATION

- A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Where exact types of hardware specified are not adaptable to finished shape or size of members requiring hardware, provide suitable types having as nearly as practical the same operation and quality as type specified, subject to Architect's approval.
- C. Review, compare, and coordinate scheduled hardware with doors, frames, and adjacent floor and wall conditions for non-compatible mounting and/or operating conditions; notify Architect in writing of any conflicts.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including excessive deflection, cracking, or breakage.
    - b. Faulty operation of operators and door hardware.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  - 2. Warranty Period: Established from date of Substantial Completion as follows:
    - a. Closers: Ten (10) years.
    - b. Locksets: Three (3) years
    - c. All other hardware: Two (2) years.

## 1.10 MAINTENANCE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

## PART 2 - PRODUCTS

Door Hardware  
08 71 00-4

## 2.1 PERFORMANCE AND REGULATORY REQUIREMENTS

- A. Regulatory Requirements: Comply with the 2010 ADA Standards for Accessible Design, ANSI A117.1, and the 2016 California Building Code.
1. Opening Hardware, Mounting Height and Operation: Operable parts of door hardware shall be 34 inches minimum and 44 inches above the floor. Hand activated door opening hardware shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist to operate; the force required to activate operable parts shall not exceed 5 lbs. Egress doors shall be readily openable from the egress side without the use of a key or special knowledge or effort. The unlatching of any door or leaf shall not require more than one operation (2016 CBC 11B-309.4 & 11B-404.2.7, 1010.1.9, 1010.1.9.5).
  2. Closers, Opening Force: The opening force shall be the push/pull effort applied perpendicular to the face of the door at the operating hardware; other than required fire rated doors, the effort to operate doors shall not exceed 5 pounds; required fire rated doors may have the opening force increased to the minimum amount necessary to close and latch the door, but shall not exceed 15 pounds (2016 CBC 11B-404.2.9).
  3. Closers, Closing Sweep Period: The closing sweep period for doors shall be such that from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch (2016 CBC 11B-404.2.8.1).
  4. Thresholds: The height differential between the tops of thresholds and adjacent floor or landing surfaces shall not be more than 1/2 inch; offsets exceeding 1/4 inch shall be beveled with a 2:1 (horizontal to vertical) maximum slope (2016 CBC 11B-404.2.5).
  5. Smooth Door Surface: The bottom 10 inches of doors shall have a smooth, uninterrupted surface to allow the door to be opened by a wheel chair footrest without creating a trap or hazardous condition (2016 CBC 11B-404.2.10).

## 2.2 SCHEDULED DOOR HARDWARE

- A. Basis of Design Products: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in Part 3 "Door Hardware Sets" Article. Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Subject to compliance with requirements, provide products indicated or comparable products by manufactures listed below:

<b>HARDWARE TYPE</b>	<b>BASIS OF DESIGN MANUFACTURER</b>	<b>MANUFACTURERS OF COMPARABLE PRODUCTS</b>
Butt Hinges	Ives	Hager, Stanley
Locksets, Latchsets, Cylinders, and key system	Schlage	
Closers	LCN	
Door Trim (Pulls, Plates, Bolts, Coordinators, Stops)	Trimco	Ives
Thresholds and Seals	Pemko	National Guard Products

### 2.3 DOOR HARDWARE PRODUCTS

- A. General: Door hardware products shall comply with referenced Accessibility Requirements.
- B. Butt Hinges: Full mortise, 3 or 5 knuckle ball bearing hinges with flat button tips, weight as indicated.
  - 1. Size: As indicated in schedule, not less than 4.5 x 4.5 inches.
  - 2. Material:
    - a. Exterior Doors: Stainless steel with stainless steel pin, and with non-removable pins.
  - 3. Quantity per Door Leaf:
    - a. 3 hinges for doors with heights of 61 to 90 inches.
- C. Continuous Gear Hinges: Full mortise, heavy duty aluminum continuous gear hinge.
- D. Pivots: Where pivots are indicated, provide top, bottom, and intermediate pivots.
- E. Lock and Latch Sets: Cylindrical or mortise latch/lock sets as scheduled with lever handled trim and as follows:
  - 1. Mortise Locksets:
    - a. Chassis: Cold-rolled steel, handing field-changeable without disassembly.
    - b. Latchbolts: 3/4 inch throw, stainless steel anti-friction type.
    - c. Lever Trim: through-bolted, accessible design, cast lever or solid extruded bar type levers as scheduled. Filled hollow tube design unacceptable.

- 1) Spindles: Security design with independent breakaway. Breakage of outside lever does not allow access to inside lever's hubworks to gain wrongful entry.
  - d. Furnish solid cylinder collars with wave springs. Wall of collar to cover rim of mortise cylinder.
  - e. Strikes: 16 gage curved steel, bronze or brass with 1 inch deep box construction and lips of sufficient length to clear trim and protect clothing.
  - f. Certifications:
    - 1) ANSI A156.13, 1994, Grade 1 Operational, Grade 1 Security.
    - 2) ANSI/ASTM F476-84 Grade 31 UL listed.
2. Cylindrical Locksets: Extra Heavy Duty and as follows:
- a. Chassis: Cylindrical design; corrosion-resistant plated cold-rolled steel, through-bolted.
  - b. Locking Spindle: Stainless steel, integrated spring and spindle design.
  - c. Latch Retractors: Forged steel; balance of inner parts corrosion-resistant plated steel or stainless steel.
  - d. Latchbolt: Solid steel.
  - e. Backset: 2-3/4 inches unless otherwise indicated.
  - f. Lever Trim: Accessible design, independent operation, spring-cage supported, minimum 2 inch clearance from lever mid-point to door face.
  - g. Strikes: 16 gage curved steel, bronze or brass with 1 inch deep box construction and lips of sufficient length to clear trim and protect clothing.
  - h. Certifications:
    - 1) ANSI A156.2, 1994, Series 4000, Grade 1.
    - 2) UL listed for A label and lesser class single doors up to 4ft x 8ft.
- F. Exit Devices: Surface mounted rim type exit devices as scheduled.
1. Certifiable by independent testing laboratory that device has completed over 1,000,000 cycles and can still meet ANSI/BHMA A156.3 - 1994 standards.
  2. Handing: Non-handed basic device design with center case interchangeable with all functions.
  3. Fluid Damper Return: Devices shall have quiet return fluid dampeners.
  4. Latchbolts: Latchbolts shall be deadlocking with  $\frac{3}{4}$ " throw and have a self-lubricating coating to reduce friction and wear.
  5. Outside Trim: As scheduled; where operating levers are provided, provide manufacturer's standard "breakaway" feature for lever trim.
  6. Strikes: All surface strikes shall be roller type and utilize a plate underneath to prevent movement.
  7. Fasteners: Exit Devices to be sex-bolted through doors.
  8. Glazing Bead Kits: Furnish glass bead kits where required for doors with glazing.
  9. Removable Mullions: Provide keyed removable mullions where indicated for pairs of doors with rim style exit devices.

- G. Surface Closers: Fully adjustable full rack-and-pinion type cylinder with cast iron body and non-ferrous cover, heat-treated pinion shaft, single piece forged piston, chrome-silicon steel spring, and as follows:
1. ISO 2000 certified; units stamped with date-of-manufacture code.
  2. Certifiable by independent testing laboratory that device has completed over 10,000,000 cycles and can still meet ANSI/BHMA A156.4
  3. Non-sized, non-handed, and fully adjustable with separate adjusting valves for closing speed, latching speed, and backcheck; and with a fourth valve for delayed action where scheduled.
  4. Arms and Mounting: Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated:
    - a. Regular Arm: Pull side, door mounted, for doors swinging into rooms.
    - b. Parallel Arm: Push side, door mounted, for doors swinging out of rooms.
    - c. Provide extra-duty arms (EDA) at exterior doors scheduled with parallel arm units.
    - d. Supplemental Brackets: Coordinate closer mounting requirements with other hardware items and provide supplemental mounting brackets where required for a complete installation.
  5. Fluid: Closers shall utilize a stable fluid withstanding a temperature range of 120 degrees F to -30 degrees F without requiring seasonal adjustment of closer speed to properly close the door. Fluid shall be non-flaming and shall not fuel door or floor covering fires.
  6. Fasteners: Closers to be sex-bolted through doors.
- H. Stops, Holders, and Bumpers: Provide units as scheduled; all doors shall be provided with a stop or bumper; stops and bumpers shall be mounted within 8 inches of the outside (strike) edge of the door and shall be not more than 4 inches from walls.
1. Overhead Stops: Provide surface mounted overhead stops where floor or wall stops, or closers with stops cannot be utilized.
  2. Flip down door mounted stops shall not be allowed.
- I. Protection Plates: Kick, armor, or mop plates, 0.050 inch thick stainless steel with four edges beveled, 2 inches less than door width; kick plates to be 10 inches high, mop and armor plate heights shall be as indicated.
- J. Lock Protectors: Fabricated from stainless steel with internally threaded fasteners for flat head machine screws through bolted to door; hex head or carriage bolt fasteners will be permitted.
- K. Thresholds: Aluminum and as detailed or scheduled; provide at all exterior doors.
- L. Door Bottoms: Provide sweep seals at out swinging exterior doors unless other types are scheduled.
- M. Rain Drips: Provide rain drips at the heads of all exterior doors where there is not enough overhang to protect the opening.

- N. Seals: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated, scheduled, or required for smoke rated openings.
  - 1. Intumescent Seals: Provide intumescent seals at fire rated openings where required by Code; comply with UL 10C.
  - 2. Resilient Seal Material: Polyurethane, polypropylene, nylon brush, silicone rubber or solid high-grade neoprene as scheduled. Vinyl seal material shall not be acceptable.
- O. Silencers: Furnish silencers for interior hollow metal frames, 3 for single doors, 2 for pairs of doors. Omit where sound or light seals occurs, or for fire-resistive-rated door assemblies.

## 2.4 KEYING

- A. Furnish a Grand Master, Master, keyed alike or keyed different system as directed by the Owner or Architect.
- B. Key Blanks: Standard "6" pin bow key blank; tag to identify.
- C. Supply keys and blanks as follows:
  - 1. Supply 2 cut change keys for each different change key code.
  - 2. Supply 1 uncut key blank for each change key code.
  - 3. Supply 6 cut master keys for each different master key set.
  - 4. Supply 3 uncut key blanks for each master key set.

## 2.5 FINISHES

- A. Generally to be satin chromium US26D (626) unless otherwise noted.
- B. Furnish push plates, pull plates and kick or armor plates in satin stainless steel US32D (630) unless otherwise noted.
- C. Door closers shall be powder-coated to match other hardware, unless otherwise noted.
- D. Aluminum items to be finished clear anodized aluminum US28 (628), except thresholds which can be furnished as standard mill finish.

## 2.6 FASTENERS

- A. Screws for strikes, face plates and similar items shall be flat head, countersunk type, provide machine screws for metal and standard wood screws for wood.
- B. Screws for butt hinges shall be flathead, countersunk, full-thread type.



- C. Fastening of closer bases or closer shoes to doors shall be by means of sex bolts and spray painted to match closer finish.
- D. Provide stainless steel expansion anchors for attaching hardware items to concrete or masonry.
- E. All exposed fasteners shall have a phillips head.
- F. Finish of exposed screws to match surface finish of hardware or other adjacent work.
- G. All exit devices and lock protectors shall be fastened to the door by the means of sex bolts or through bolts.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Verify that doors and frames are square and plumb and ready to receive work and dimensions are as instructed by the manufacturer.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Beginning of installation means acceptance of existing conditions.

#### 3.2 INSTALLATION

- A. Install each door hardware item to comply with manufacturer's written instructions and requirements of the Door Hardware Institute. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- B. Use the templates provided by hardware item manufacturer.
- C. Mounting heights for hardware shall be as recommended by the Door and Hardware Institute.
  - 1. Operating hardware shall be located between 34 and 44 inches above the floor to comply with requirements of the 2016 California Building Code and the 2010 ADA Standards for Accessible Design.
- D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

- E. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- F. Thresholds: Set thresholds for exterior doors in a full bed of butyl-rubber sealant, secure to concrete substrates with 1/4 inch diameter stainless steel flat head sleeve anchors equally spaced not more than 12 inches on center and not more than 3 inches from ends.
- G. If hand of door is changed during construction, make necessary changes in hardware at no additional cost to the owner.

### 3.3 FIELD QUALITY CONTROL

- A. Supplier's Architectural Hardware Consultant (AHC), with installer present, shall inspect and test installed door hardware operation with the building's climate control system at rest and in full operation. Architectural Hardware Consultant shall certify that hardware has been furnished and installed in accordance with the Contract Documents, manufacturer's instructions, as specified herein, and that door hardware operates as intended.

### 3.4 ADJUSTING

- A. General: Adjust door latches and closers with heating and ventilating equipment fans in operation in order to compensate for room-to-room or room-to-exterior air pressure differences.
- B. Door Closers: Adjust door closers so that the effort to operate doors shall not exceed 5 pounds for non-fire rated doors and 15 pounds maximum for fire rated doors; the force shall be the push/pull effort applied at right angles to hinged doors. (2016 CBC 11B-404.2.9). Adjust the sweep period for closers so that from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch (2016 CBC 11B-404.2.8.1).
- C. Initial Adjustment: Approximately 2 weeks prior to completion or occupancy, adjust and check each operating item of door hardware and each door to ensure proper operation and function of every unit. Replace units that cannot be adjusted to operate freely and smoothly as intended for the application installed.
- D. Occupancy Adjustment and Service: Approximately six months after the completion of the project, the Contractor, accompanied by the Architectural Hardware Consultant, shall return to the project and re-adjust every item of hardware to restore proper functions of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.5 CLEANING AND PROTECTION

- A. Clean adjacent surface soiled by hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DEMONSTRATION AND TRAINING

- A. Instruct Owner's Personnel to adjust, operate, and maintain door hardware and door hardware finishes during the final adjustment of hardware.

3.7 DOOR HARDWARE SETS

- A. The items listed in the following Hardware Sets shall conform to the requirements of the foregoing specifications.
- B. The Door Schedule on the Drawings indicates hardware sets for each door.
- C. Abbreviations for Manufacturers:

HAG = Hager	Hinges
IVE = Ives	Door trim, bolts, plates
GJ = Glynn-Johnson	Overhead stops, coordinators
AR = Adams Rite	3 point locking
LCN = LCN	Door Closers
PEM = Pemko	Thresholds, Gasketing & Weatherstrip
SCH = Schlage Lock Company	Locks, Latches & Cylinders
TRI = Trimco	Protection Plates, & Stops
ZER = Zero International	Applied Jamb Stops

- D. Door Hardware Sets:

**k**

Each to have the following:

3	Ea	Butt Hinge	BB1191 4.5 x 4.5 NRP	630	HAG
1	Ea	Lockset	ND#PD , RHO	626	SCH
1	Ea	Surface Closer	4111 (parallel arm)	689	LCN
1	Ea	Kick Plate	KO050 10" X 2" LDW	630	TRI
1	Ea	Stop		626	TRI
2	Set	Seal	S88D 17'		PEM
2	Ea	Door Sweep	216AS 36"		PEM
1	Ea	Threshold	158A		PEM

END OF SECTION

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## SECTION 09 29 00

### GYPSUM BOARD

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Interior gypsum board.
- B. Related Sections include, but are not limited to the following:
  - 1. Division 07 Section "Thermal Insulation" for batt and blanket insulation and vapor retarders installed in assemblies that incorporate gypsum board.
  - 2. Division 09 Section "Painting" for primers applied to gypsum board surfaces.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's product data for each type of product indicated or incorporated into the Work.
  - 1. Include statement of VOC content for any adhesives or sealants.
- B. Samples: For the following products:
  - 1. Textured Finishes: Three (3) 18 inch square samples for each textured finish indicated and on same backing indicated for Work.

##### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

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1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD, GENERAL

- A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
  - 1. Width: 4 feet.
  - 2. Length: 8, 10, or 12 feet.

2.2 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Gypsum Co.
  - 2. Georgia-Pacific Gypsum, LLC.
  - 3. Lafarge North America Inc.
  - 4. National Gypsum Company.
  - 5. PABCO Gypsum.
  - 6. USG Corporation.
- B. Gypsum Wallboard: Provide gypsum wallboard complying with ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated.
  - 1. Regular Type:
    - a. Thickness: 5/8 inch.
    - b. Long Edges: Tapered.

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2. Glass-Mat Faced Gypsum Board: ASTM C 1178/C 1178M. With fiberglass mat laminated to both sides. Specifically designed for interior use.
  - a. Core: 5/8 inch, regular, water-resistant.
  - b. Long Edges: Tapered.
  - c. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

## 2.3 TRIM ACCESSORIES

### A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:
  - a. Cornerbead.
  - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
  - c. L-Bead: L-shaped; exposed long flange receives joint compound.
  - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.

## 2.4 JOINT TREATMENT MATERIALS

### A. General: Comply with ASTM C 475/C 475M.

### B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Glass Mat Panels: Glass-fiber mesh tape, 10x10, 2 inches wide.

### C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

## 2.5 AUXILIARY MATERIALS

### A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

### B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

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1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
  1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick (20 gage structural and heavier).
- D. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."
  1. Sealants shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.6 TEXTURE FINISHES

- A. Primer: As recommended by textured finish manufacturer.
  1. Coordinate primers with Division 09 Section "Painting."
- B. Non-Aggregate Finish: Pre-mixed, vinyl texture finish for spray application.
  1. Texture: Spatter knock-down unless otherwise indicated; Orange Peel at restrooms.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLYING AND FINISHING GYPSUM PANELS, GENERAL

- A. Comply with ASTM C 840 and manufacturer's written installation instructions.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

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- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of roof, cut gypsum panels to fit profile formed by structural members; allow 1/4 to 3/8-inch wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4 to 1/2-inch wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

### 3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Regular Type: At vertical and horizontal surfaces, unless otherwise indicated.
  - 2. Glass Mat Type: At walls of rest room, walls within 2 feet (horizontally) of plumbing fixtures, and other locations as indicated on Drawings.
- B. Single-Layer Application:
  - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
  - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) using continuous panels without abutting end joints unless otherwise indicated or required by fire-resistance-rated design.



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- a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
  - b. At high walls where the vertical dimension of the wall without horizontal offsets exceeds the maximum available panel length, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated design.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

### 3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings and according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
  1. Cornerbead: Use at outside corners, unless otherwise indicated.
  2. LC-Bead: Use at exposed panel edges.
  3. L-Bead: Use at exposed panel edges where LC-Bead cannot be used.
  4. U-Bead: Use where indicated.

### 3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  1. Level 1: All joints and interior angles shall have tape embedded in joint compound; surface shall be free of excess joint compound; tool marks and ridges are acceptable.
    - a. Locations: Concealed areas and areas above ceilings.

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2. Level 2: All joints and interior angles shall have tape embedded in joint compound and one separate coat of joint compound applied over all joints, angles, fastener heads, and accessories; surface shall be free of excess joint compound; tool marks and ridges are acceptable.
  - a. Locations: Panels that are substrate for applied rigid panels having a thickness not less than 3/8 inches.
3. Level 3: All joints and interior angles shall have tape embedded in joint compound and two (2) separate coats of joint compound applied over all joints, angles, fastener heads, and accessories; all joint compound shall be smooth and free of tool marks and ridges.
  - a. Locations: Not used unless otherwise indicated on Drawings.
  - b. Locations: At panel surfaces that will be exposed to view and painted or will be substrates for wall coverings.
  - c. Primer and its application to surfaces are specified in Division 09 Section "Painting."
  - d. Where suspended ceilings are to be installed, wall finish shall extend not less than 6 inches above the ceiling height.

### 3.6 APPLYING TEXTURE FINISHES

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes prior to application of finishes. Apply primer to surfaces that are clean, dry, and smooth.
- B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture free of starved spots or other evidence of thin application or of application patterns.
- C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

### 3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

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1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

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## SECTION 09 90 00

### PAINTING AND COATING (SITE WORK)

#### PART 1 GENERAL

##### 1.1 WORK INCLUDED

- A. Field painting including surface preparation, surface protection, clean up, and/or other appurtenant work.
- B. All labor, materials, tools and equipment, and incidentals necessary and required for their completion.
- C. All pipe, fittings, equipment, and structures are to be field coated except for those specific exceptions contained in this specification or identified on the drawings. The painting schedule included at the end of this specification summarizes the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the drawings are used to show exceptions to the schedules, to extend the limits of coating systems, or to clarify or show details for application of the coating systems.

##### 1.2 RELATED WORK

- A. Section 03 30 01 – Cast-in-Place Concrete (Site Work)

##### 1.3 SUBMITTALS

- A. Submittals shall be in accordance with the General Provision.
- B. As specified in Section 01 33 00 – Submittal Procedures
  - 1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Performance criteria as required by the Engineer to determine quality.
    - c. Manufacturer's installation instructions and environmental parameters.
    - d. Material Safety Data Sheets.
    - e. Color samples.

#### 1.4 AIR QUALITY REGULATORY COMPLIANCE

- A. All paint shall conform to the applicable air quality regulations at the point of application. Any paint material which cannot be guaranteed by the manufacturer to comply, whether specified by product designation or not, shall not be used.
- B. The volatile organic compound (VOC) of coatings materials limits set forth in Rule 460.1 of the San Joaquin Valley Unified Air Pollution Control District shall apply to this project. The manufacturers' products listed in paragraphs 09900-3.01 and 3.02 have been selected on the basis of their apparent compliance with Rule 460.1; however, it shall remain the Contractor's responsibility to ensure that all coatings materials furnished are in compliance with all regulatory agencies.
- C. The product listed may meet the VOC requirement in the unthinned (as shipped) condition, but may exceed the VOC requirement if thinned to the manufacturer's allowable recommendations. In this situation, the product is not to be thinned beyond the limit indicated in Rule 460.1, and if the product cannot be suitably thinned for the intended application method or temperature requirements, it will be necessary to use another manufacturer's product subject to acceptance by the Engineer.
- D. It shall be the responsibility of the Contractor to ensure the compatibility of the field painting products which will be in contact with each other or which will be applied over shop painted or previously painted surfaces. Paint used in successive field coats shall be produced by the same manufacturer. Paint used in the first field coat over shop or field primed surfaces, or previously painted surfaces shall cause no wrinkling, lifting, or other damage to underlying paint.
- E. All paint used for intermediate and finish coats shall be guaranteed by the paint manufacturer to be fume proof. Paint shall be lead-free and mercury-free.

#### 1.5 QUALITY OF WORK

- A. All finishes shall be applied by skilled workmen in accordance with the best practices and standards of the painting trade. Brushes, rollers, all equipment, and the techniques used in applying finishes shall be of sufficient quality to assure the specified results. Work not conforming to this Specification shall be corrected by touching up or refinishing as directed by the Engineer.
- B. It is the purpose and intent of this Specification to cover the complete paint finishing of all exterior and interior surfaces as scheduled or specified and all surfaces which normally require a paint finish for corrosion resistance, weather protection, finished appearance or utility. Finished surfaces shall be of the type of finish, color sheen film thickness and quality specified.

#### 1.6 DELIVERY AND STORAGE

- A. Painting materials shall be delivered to site in manufacturer's original containers with labels intact and seals unbroken. Painting materials and equipment shall be

stored and protected against freezing and mixed in rooms assigned for that purpose. No chemicals, unauthorized thinners, or other materials, not included in the paint formulation shall be added to the paint for any purpose. All necessary precautions shall be taken to prevent fire. Rags or waste soiled with paint shall be removed from premises at end of each day's work, or shall be stored in covered metal containers.

### 1.7 *EQUIVALENT PRODUCTS*

- A. Whenever a coating is specified using the name of a proprietary product or the name of a particular manufacturer or vendor, the specified coating shall be understood as establishing the type and quality of coating desired.
- B. Other manufacturers' products will be accepted provided sufficient information is submitted to allow the Engineer to determine that the coatings proposed are equivalent to those named. Proposed coatings shall be submitted for review in accordance with the Section 01 33 00 - Submittals.
- C. Requests for review of equivalency will not be accepted from anyone except the Contractor, and such requests will not be considered until after the contract has been awarded.
- D. Specific products for various applications shall be as specified in Part 2. In addition to the products named in Part 2, equivalent products of the following manufacturers will also be acceptable:

Ameron  
Carboline  
Devoe  
PPG (Pittsburgh)  
Sherwin Williams Co.  
Sinclair  
Tnemec  
Valspar

- E. Contractor shall provide verification that equivalent products are acceptable for the desired application.

### 1.8 *REFERENCE STANDARDS*

- A. SSPC – Society of Protective Coatings, Pittsburgh, PA
- B. ASTM – American Society For Testing And Materials, West Conshohocken, PA

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- A. All paint shall be the product of a recognized manufacturer exclusively engaged in the manufacture of painting material. All paints for wood and metal surfaces shall be well-ground and shall not skin, liver, curdle, or body excessively in the containers.
- B. The paint shall not show laps or unevenness of color or texture. When applied to vertical surfaces, it shall not sag.
- C. All exposed surfaces, including sides and edges, shall be painted. Hangers, brackets, fastenings and other miscellaneous items shall be painted with the same system as the adjacent material. Paint systems shall be in addition to shop primers.
- D. Paint shall be stored inside and shall be protected against freezing. No adulterant, unauthorized thinner, or other material not included in the paint formation shall be added to the paint for any purpose.
- E. Paint used in successive field coats shall be produced by the same manufacturer. Paint used in the first field coat over shop painted or previously painted surfaces shall cause no wrinkling, lifting, or other damage to underlying paint. Any paint system shall be the product of a single manufacturer.
- F. All paint used for intermediate and finish coats shall be guaranteed by the paint manufacturer to be lead-free, mercury-free, and fumeproof. Where paint materials are referenced to Federal or military specifications, the reference shall define general type and quality required but is not intended to limit acceptable materials to an exact formulation.
- G. For each paint, the Contractor shall follow the paint manufacturer's specific application instructions. Upon the Engineer's request, the Contractor shall furnish the following application instructions.
  - 1. Surface preparation recommendations.
  - 2. Type of primer to be used.
  - 3. Maximum dry and wet mil thickness per coat.
  - 4. Minimum and maximum curing times between coats.
  - 5. Thinner to be used with each paint.
  - 6. Ventilation requirements.
  - 7. Atmospheric conditions during which the paint shall not be applied.

8. Allowable methods of application.
  9. Maximum allowable moisture content and minimum age of plaster, concrete and wood surfaces at time of paint application.
  10. Curing time before submergence in water.
- H. The minimum number of coats and minimum total dry mil thickness of the system for each surface shall be as specified in the paint schedule.

## 2.2 PAINTING SCHEDULE

- A. A schedule is appended to this section listing the surface preparation, primer, finish and dry mil thickness to be used on each surface to be coated.

## 2.3 PRIMERS AND PRETREATMENT

- A. P-1 Epoxy Primer - Minimum dry thickness 4 mils. Devoe "Bar Rust 235H", Sherwin Williams "Macropoxy 646 FC Epoxy B58-600", or Tnemec 69-1211 "Hi-Build Expoxoline."
- B. P-2 Rust Inhibitive, non-submerged - Minimum dry thickness 3 mils. Devoe "Devran 203 Waterborne Epoxy Primer", Sherwin Williams "Macropoxy 646 FC Epoxy B58-600" or Tnemec 135 "Chem Build."
- C. P-3 Rust inhibitive, submerged - Minimum dry thickness 4.0 mils. Devoe "Bar Rust 235H", Sherwin Williams "Macropoxy 646 FC Epoxy B58-600" or Tnemec 136 "Chem Build."
- D. P-4 Primer for Wood – Maximum of 400 sq. ft/gal. Devoe 2010-1200 "Ultra- Hide Durus Exterior Acrylic Primecoat", Sherwin Williams "A-100 Wood Primer B42W41" or Tnemec 151 "Elaso-Grip."
- E. P-5 Wallboard Primer – Maximum of 400 sq. ft/gal. Devoe 1060-1200 "Ultra- Hide Latex Primer- Sealer", Sherwin Williams "Preprite 200 Interior Latex Primer B28W200", or Tnemec 51-792 "PVA Sealer."
- F. P-6 High Build Acrylic – Maximum of 100 sq. ft/gal., Tnemec 180 WB Tnemecrete, Sherwin Williams "Heavy Duty Block Filler B42W46".

## 2.4 INTERMEDIATE AND FINISH PAINTS

- A. F-1 Epoxy Resin - Minimum dry thickness 5 mils. Devoe "Bar Rust 235H", Sherwin Williams "Macropoxy 646 FC Epoxy B58-600", or Tnemec 69 "Hi-Build" epoxy.
- B. F-2 Gloss Acrylic Emulsion - Minimum dry thickness 2.0 mils Devoe " Devflex 4208 Waterbone Acrylic Enamel", Sherwin Williams "Shercryl Hi Performance Acrylic Gloss B66-300", or Tnemec 1028.



- C. F-3 Semi-gloss Acrylic Emulsion - Minimum dry thickness 2.5 mils Devoe “Devvflex 4216 HP Waterborne”, Sherwin Williams “Shercryn Hi Performance Acrylic Semi-Gloss B66-350”, or Tnemec 1029 “Tuf Cryl”.
- D. F-4 High Build Epoxy (Substitute for Coal Tar) - Minimum dry thickness 6 mils. Devoe “Devtar 5A HS”, Sherwin Williams “Targuard Coal Tar Epoxy B69B60”, or Tnemec “V69F Black”
- E. F-5 Polyurethane O - Minimum dry thickness 2 mils. Devoe “Devthane 379H Aliphatic Urethane Gloss Enamel”, Sherwin Williams “Hi Solids Polyurethane CA B65j-300”, or Tnemec 1075 “Endurasheild.”
- F. F-6 Acrylic Epoxy – Minimum dry film thickness 4 mils. Tnemec 113 Tneme-Tufcoat, Sherwin Williams “ Waterbased Tile Clad Epoxy B73-100”.
- G. F-7 High Build Acrylic – Maximum of 100 sq. ft./gal. Tnemec 180 WB Tneme-Crete, Sherwin Williams “Heavy Duty Block Filler B42W46”.

## 2.5 FUSION BONDED EPOXY LINING AND COATING

- A. Lining and coating shall be a 100% solids, thermosetting, fusion-bonded, dry powder epoxy resin. Provide Scotchkote 134 or 206N, Lilly Powder Coatings "Pipeclad 1500 Red", or equal. Epoxy lining and coating shall meet or exceed the following requirements:

Hardness (Minimum):	Barcol 17 (ASTM D 2583) Rockwell 50 (“M” Scale)
Abrasion Resistance (Minimum)	1,000 cycles: 0.05 gram removed 5,000 cycles: 0.115 gram removed ASTM D 1044, Tabor CS 17 wheel 1,000 gram weight
Adhesion (Minimum)	3,000 psi (Elcometer)
Tensile Strength	7,300 psi (ASTM D 2370)

## 2.6 ALUMINUM SURFACES

- A. All aluminum in contact with steel or concrete: Sherwin Williams “Macropoxy 646 FC Epoxy B58-600 series or approved equivalent..

## 2.7 SHOP COATINGS

- A. Shop coatings shall be applied as indicated in the individual equipment and component specifications.
- B. Electric motors, speed reducers, starters, and other self contained or enclosed components shall be shop primed or finished with a high grade, oil resistant enamel suitable for top coating in the field with an alkyd enamel.

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- C. All shop coatings shall be compatible with the pain system specified in the Painting Schedule contained at the end of this specification.

## 2.8 SURFACES NOT TO BE PAINTED

- A. Except as otherwise required or directed, the following surfaces are to be left unpainted:
  - 1. Exposed surfaces of aluminum (aluminum in contact with concrete is to be coated).
  - 2. Polished or finished stainless steel. Unfinished stainless steel shall be painted.
  - 3. Nickel or chromium.
  - 4. Galvanized surfaces, except piping, conduit, electrical conduit, pipe supports, fasteners, hangers, bracing, brackets, and accessories.
  - 5. Rubber and plastics, including fiberglass reinforced plastics.
  - 6. Precast concrete.

## 2.9 SYSTEM IDENTIFICATION

- A. Above Grade Piping: Provide markers on piping which is either exposed or concealed in accessible spaces. For piping systems, other than drain and vent lines, indicate the fluid conveyed or its abbreviation, either by preprinted marker or stenciled marking, and include arrows to show the direction of flow. Comply with ANSI A13.1 for colors. Locate markers at ends of lines, near major branches and other interruptions including equipment in the line, where lines pass through floor, walls or ceilings or otherwise pass into inaccessible spaces, and at 50' maximum intervals along exposed portion of lines. Marking of short branches and repetitive branches for equipment connections is not required.
- B. Equipment: All equipment shall be identified with a plastic laminated, engraved nameplate which bears the unit mark number as indicated on the drawings (e.g. AC-4). Provide 1/2" high lettering, white on black background. Nameplates shall be permanently secured to the unit.
- C. Valves: Provide valve tags on all valves of each piping system, excluding check valves, valves within equipment, faucets, stops and shut-off valves at fixtures and other repetitive terminal units. Provide brass tags or plastic laminate tags. Prepare and submit a tagged valve schedule, listing each valve by tag number, location and piping service. Mount in glazed frame where directed.

## 2.10 COLORS

- A. All colors and shades of colors shall be as specifically indicated in the specifications or plans, or, where not specifically indicated, selected from the manufacturer's standard color samples by the Owner.
- B. Electrical conduit shall be painted to match adjacent ceiling or wall surfaces as directed by the Engineer.

## PART 3 EXECUTION

### 3.1 PRELIMINARY EXAMINATION

- A. Notify the Engineer in writing of any uncorrected defects in surfaces to be painted. Do not proceed with the finishing of surfaces in question until any discrepancies are corrected. No work on any surface shall be started, unless the surface has been inspected and approved for painting by the Engineer.

### 3.2 SURFACE PREPARATION

- A. The Contractor shall prepare the surfaces to be coated as specified under the paint schedule. Any surfaces to be coated which are not listed under the paint schedule shall be prepared in accordance with the manufacturer's instructions for the material to be applied.
- B. All grease, oil, dirt, and other contaminants which may affect the bond between the coating and the surface shall be removed by a cleaning agent which will leave the surface clean and dry.
- C. Cleaning and painting operations shall be performed in a manner which will prevent dust or other contaminants from getting on freshly painted surfaces.
- D. Surfaces shall be free of cracks, pits, projections, or other imperfections which would prevent the formation of smooth, unbroken paint film, except for concrete block construction where a rough surface is an inherent characteristic.
- E. When applying touch-up paint, or repairing previously painted surfaces, the surfaces to be painted shall be cleaned and sanded or wire brushed in such a manner that the edges of adjacent paint are feathered or otherwise smoothed so that they will not be noticeable when painted. All paint made brittle or otherwise damaged by heat or welding shall be completely removed.
- F. Hardware items such as bolts, screws, washers, springs, and grease fittings need not be cleaned prior to painting if there is no evidence of dirt, corrosion, or foreign material.
- G. All galvanized surfaces shall have a metal conditioner applied prior to the first prime coat.

- H. All surfaces to be finished shall be clean and dry before any materials are applied. Use a moisture meter to determine moisture content as follows. The moisture content shall be less than 18% for wood; 8% for concrete or plaster.
1. Metal Surfaces - Where noted, the surface preparation for steel and other metals refer to the specifications for surface preparation by the latest revision of the Steel Structures Painting Council. All metal work shall be cleaned of grease, oil and dirt by solvent cleaning (SSPC-SP1). Do not use hydrocarbon based solvents for cleaning prior to use of acrylic materials.
    - a. Method SP-2: Surface shall be wire brushed where required to remove loose rust and dirt, etc. (SSPC-SP2)
    - b. Method SP-3: Removal of loose rust, loose mill scale and other detrimental foreign matter to degree specified by power wire brushing, power impact tools or power sanders. (SSPC-SP3)
    - c. Method SP-6: Blast cleaning until at least two-thirds of each element of surface area is free of all visible residues. (SSPC-SP6)
    - d. Method SP-10: Sandblast to near white condition. This method shall remove all rust and scale, but streaks and shadows in the metal will be acceptable. (SSPC-SP10)
  2. Wood Surfaces
    - a. Method W-1: All unprimed millwork delivered to the jobsite shall be given the specified first coat on all surfaces immediately upon arrival. Give all unprimed woodwork the specified first coat as soon as possible following installation. Prime any wood surface that is to be in contact with concrete, or a caulking material, with the specified first coat material before installation. Unless specified otherwise, all casings and trim, and all woodwork shall be free of oil, dirt, loose fibers, etc., sealed with a sanding sealer recommended by the coating manufacturer, and sanded smooth and dusted thoroughly before application of the priming coat. Give all knots, pitch pockets and sappy areas a preliminary coat of Dutch Boy Knot Sealer, or approved equivalent, prior to application of the prime coat.
  3. Galvanized Surfaces
    - a. Method G-1: All galvanized surfaces shall be prepared for painting in strict conformity with the instructions of the manufacturer. All galvanized shall be cleaned per SSPC-SP7.
  4. PVC Pipe

- a. Method V-1: All wax and oil shall be removed from PVC plastic surfaces by wiping with a solvent of the type used for the specified primer.

### 3.3 PAINT APPLICATION

- A. Apply all finishes evenly, free from sags, runs, crawls, brush marks, skips or other defects. Apply products at the proper consistency and do not thin or otherwise alter them except in accordance with the manufacturer's printed directions. All coats shall be applied in such manner as to produce an even film of uniform thickness completely coating all corners and crevices. All painting shall be done by thoroughly experienced workmen.
- B. Care shall be exercised during spraying to hold the nozzle sufficiently close to the surfaces being painted to avoid excessive evaporation of the volatile constituents and loss of material into the air, or the bridging over of crevices and corners. Spray equipment shall be equipped with mechanical agitators, pressure gauges, and pressure regulators. Nozzles shall be of proper size. Floors, roofs, and other adjacent areas and installations shall be satisfactorily protected by drop cloths or other precautionary measures. All over-spray shall be removed by approved methods or the affected surface repainted. Care shall be exercised to avoid lapping of paint on hardware of other unscheduled surfaces.
- C. Each coat of material shall be thoroughly dry before the application of a succeeding coat. In no case shall paint be applied at a rate of coverage per gallon which is greater than the maximum rate recommended by the manufacturer. Paint films showing sags, checks, blisters, teardrops, or fat edges will not be accepted. Paint containing any of these defects shall be entirely removed and the surface repainted.
- D. Sandpaper enamels and varnishes lightly between coats and dust thoroughly before the application of a succeeding coat.
- E. If the finish coat is to be colored, the prime coat and the intermediate coat shall be tinted to have a slight variation in color from each other and from the finish coat.

### 3.4 PRIMING

- A. Edges, corners, crevices, welds, and bolts shall be given a brush coat of primer before the specified spot or touch-up painting of metal surfaces. Special attention shall be given to filling all crevices with paint.
- B. Abraded and otherwise damaged portions of shop applied paint shall be repainted. Welded seams and other uncoated surfaces, heads and nuts of field installed bolts, and surfaces where paint has been damaged by heat, shall be given a coat of the specified primer. This patch, spot, or touch-up painting shall be completed, and shall be dry and hard, before additional paint is applied.

### 3.5 *LATEX PAINT*

- A. Latex paint shall be applied by brushing or rolling; spraying is not permitted. Latex paint shall not be thinned excessively.

### 3.6 *MIXING AND THINNING*

- A. Paint shall be thoroughly mixed each time any is withdrawn from the container. Paint containers shall be kept tightly closed except while paint is being withdrawn.
- B. Unless otherwise authorized, all paint shall be factory mixed to proper consistency and viscosity for hot weather application without thinning. Thinning will be permitted only as necessary to obtain recommended coverage at lower application temperatures. In no case shall the wet film thickness of applied paint be reduced, by addition of paint thinner or otherwise, below that represented by the recommended coverage rate.

### 3.7 *FILM THICKNESS FOR FERROUS METALS*

- A. It is intended that the dry film thickness and the continuity of painted ferrous metal surfaces be subject to continual field check by the Engineer. Dry film thickness shall be measured by the Contractor, using an approved Thickness Gauge, at locations selected by Engineer. Testing equipment provided shall be provided by Contractor and kept on site.
- B. Measurement of Dry Coating Thickness shall conform with paint application Standard SSPC-PA2
- C. Thickness and Holiday Checking - Thickness of coatings and paint shall be checked with a non-destructive, magnetic type thickness gauge.
- D. Holiday Checking of all interior coated surfaces shall be tested with an approved holiday detection device. Non-destructive holiday detectors shall not exceed 100 volts nor shall destructive holiday detectors exceed the voltage recommended by the manufacturer of the coating system. For thicknesses between 10 and 20 mils (0.25mm and 0.50mm) a non-sudsing type wetting agent such as Kodak Photo-Flo, shall be added to the water prior to wetting the detector sponge. All pinholes shall be marked, repaired in accordance with the manufacturer's printed recommendations and re-tested. No pinholes or other irregularities will be permitted in the final coating. Holiday detection devices shall be operated in the presence of the Engineer.
- E. Continuity shall be tested by a low voltage-wet sponge per RPO 188. Contractor shall perform continuity tests as required by the Engineer on surfaces that will be submerged.

### 3.8 *ATMOSPHERIC CONDITIONS*

- A. Apply all material to dry and properly prepared surfaces when weather conditions are favorable for painting. No materials shall be applied when the temperature of the materials is below 50 degrees F, or when the temperature of the air, surface to be painted or substrate, is below (or likely to fall below) 50 degrees F. Final ruling on the favorability of weather conditions shall be in accordance with the recommendations of the manufacturer and/or the Engineer.
- B. No coating or paint shall be applied to wet or damp surfaces, in rain, snow, fog, or mist, when the steel temperature or surrounding air temperature is less than 5 degrees above the dew point, nor in conditions not recommended by the manufacturer

### 3.9 *REPAIRING DAMAGED PAINT ON EQUIPMENT*

- A. Painted surfaces on equipment, which have become damaged prior to acceptance by the Owner, shall be repainted with the same or equivalent paint used in the original application.

### 3.10 *PROTECTION OF SURFACES*

- A. Throughout the work the Contractor shall use drop cloths, masking tapes, and other suitable measures to protect all surfaces from accidental spraying, splattering, or spilling of paint. Contractor shall be liable for and shall correct and repair any damaged condition resulting from its operations or from the operations of all those who are responsible to the Contractor during the time its work is in progress and until the work is accepted. In case bituminous paints are spilled or dropped on any material except metals, the spots shall, after surface cleaning, be spot painted with aluminum paint prior to applying the specified paint. Any exposed concrete or masonry not specified to be painted which is damaged by paint shall be either removed and rebuilt or, where so authorized by the Owner, painted with two coats of masonry paint.

### 3.11 *CLEANUP*

- A. All cloths and cotton waste which might constitute a fire hazard shall be placed in metal containers or destroyed at the end of each work day. Upon completion of the work all staging, scaffolding and containers shall be removed from the site or destroyed in a manner approved by the Engineer.

3.12 PAINTING SCHEDULE

<u>SYSTEM</u>	<u>SURFACE</u>	<u>FINISH</u>			
		<u>SURF. PREP.</u>	<u>PRIME COAT</u>	<u>2<sup>ND</sup> COAT</u>	<u>3<sup>RD</sup> COAT</u>
1.	New ferrous metal in submerged or damp environment including all submerged mechanical components.	SP-10	P-1	F-1	F-1
2.	All exterior exposed new structural and miscellaneous steel. All exterior exposed surfaces of new piping, pumps, motors, electrical equipment and other unsubmerged mechanical and structural items.	SP-2 or 3	P-2	F-2	F-2
3.	All surfaces of new structural and miscellaneous steel pipe, pumps, motors and electrical equipment panels exposed inside building.	SP-6	P-2	F-3	F-3
4.	All interior exposed new galvanized metalwork including electrical conduit inside buildings, including fittings, boxes, supports and accessories.	G-1	P-3	F-3	F-3
5.	All exterior exposed new galvanized metalwork including roof flashings and other architectural items.	G-1	P-3	F-2	F-2
6.	Exposed new PVC piping	V-1	F-5	F-5	



7.	All new buried valves and flanged joints and other buried miscellaneous ferrous piping and metal surfaces (excluding cast iron pipe). All exterior surfaces of new cast iron and steel piping exposed in manholes, wet wells and similar locations, including valves, fittings, flanges, bolts, supports, and accessories. Miscellaneous new castings, including manhole rings and covers and manhole steps. (One coat, if not foundry dipped.)	SP-10	F-4	F-4
8.	Interior wood	P-4	F-2	F-2
9.	Exterior wood	P-4	F-3	F-3
10.	Interior dry wall	P-5	F-6	
11.	Exterior concrete block	P-6	F-7	
12.	Concrete	P-6	F-7	

*3.13 When conflicting painting specifications or requirements are encountered in the contract documents, the more restrictive specifications or requirements shall be required.*

**END OF SECTION**

## SECTION 09 91 00

### PAINTING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this Section.

##### 1.2 SUMMARY

- A. This Section includes surface preparation and field painting, staining or refinishing of the following:
  - 1. Exposed exterior items and surfaces.
  - 2. Exposed interior items and surfaces.
  - 3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Related Sections include but are not limited to the following:
  - 1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
  - 2. Division 08 Sections for shop priming of metal doors and frames with primers specified in this Section.
  - 3. Division 09 Section "Gypsum Board" for sealing gypsum board surfaces before application of surface textures with primers/sealers specified in this Section.
  - 4. Division 21 through 23 Sections for additional requirements for painting of plumbing and mechanical items.
  - 5. Division 26 through 28 Sections for additional requirements for painting of electrical items.

##### 1.3 DEFINITIONS

- A. Definitions of gloss levels below are from "MPI Architectural Painting Specification Manual" (hereafter, "MPI Manual").
  - 1. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
  - 2. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

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3. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
4. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
5. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
6. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
  1. Submit Samples on 8 inch square samples of actual material to be painted or stained. For masonry surfaces, include a mortar joint.
  2. Step coats on Samples to show each coat required for system.
  3. Label each coat of each Sample.
  4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
  1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
  2. VOC content.

#### 1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
  1. Product name or title of material.
  2. Product description (generic classification or binder type).

3. Manufacturer's stock number and date of manufacture.
  4. Contents by volume, for pigment and vehicle constituents.
  5. Thinning instructions.
  6. Application instructions.
  7. Color name and number.
  8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F.
1. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
  2. Keep storage area neat and orderly. Remove oily rags and waste daily.
  3. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

#### 1.7 PROJECT CONDITIONS

- A. Apply paints only when the temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- C. Protection:
1. Cover or otherwise protect finished work of other trades, work not to be painted concurrently, landscaping, and adjacent property from damage.
  2. When not in use, store paints in designated areas. Keep containers closed. At end of day's work, remove empty containers, paint soaked rags, and debris. Vent fumes. Take precautions to prevent fire.
- D. Sequencing, Scheduling:
1. Coordinate removal and replacement of hardware, electrical fixtures and trim, and related work of other Sections.
  2. Stain, prime, back paint, and pre-finish items before installation as required.
- E. Cleaning and Disposal:
1. Do not use Project plumbing fixtures or piping systems for:
    - a. Cleaning painting equipment and utensils.
    - b. Disposal of waste from cleaning or disposal of paints.

## PART 2 - PRODUCTS

### 2.1 SCHEDULED PAINT SYSTEMS

- A. Provide paint systems as scheduled in Part 3 Article "Paint Systems" to comply with requirements in this Section.
1. Named Manufacturers' Products: Manufacturer and product designations indicated in the scheduled paint systems are for the purpose of establishing minimum requirements; unless otherwise indicated, paint products are based on products manufactured by the following:
    - a. Frazee Paints.
      - 1) Subject to compliance with requirements, provide the named products or equivalent products by one of the following:
        - a) Dunn-Edwards Paints.
        - b) Fuller O'Brien Paints.
        - c) Glidden Professional.
        - d) Kelly-Moore Paints.
        - e) Sherwin Williams Paints.
        - f) Tnemec.

### 2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
1. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
- C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction and for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
1. Flat Paints and Coatings: 50 g/L.
  2. Nonflat Paints and Coatings: 150 g/L.
  3. Dry-Fog Coatings: 400 g/L.
  4. Primers, Sealers, and Undercoaters: 200 g/L.
  5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
  6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
  7. Pretreatment Wash Primers: 420 g/L.

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8. Floor Coatings: 100 g/L.
  9. Shellacs, Clear: 730 g/L.
  10. Shellacs, Pigmented: 550 g/L.
- D. V.O.C. Limits: Paints and Coatings shall comply with the product and documentation requirements of the 2016 California Green Building Standards, section 5.504.4.3
- E. Colors: Provide color selections made by the Owner. Colors shall be factory mixed and match approved samples.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
  2. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
1. Application of coating indicates acceptance of surfaces and conditions.
- F. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
1. Notify the Architect of anticipated problems using the materials specified over substrates primed by others.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because

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of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. Electrical Items: Remove only switch and outlet cover plates and similar items that do not require disconnecting wiring. Do not disconnect wiring or remove electrical fixtures, switches, or control devices unless otherwise indicated on Electrical Drawings.
  2. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
  2. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Perform appropriate tests to determine alkalinity and moisture content of surfaces; testing shall be performed or witnessed by a certified representative of the paint manufacturer. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
1. Cracks and defects at concrete and masonry surfaces shall be filled with cement grout; match surface texture.
  2. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
1. Steel Structures Painting Council's (SSPC), SSPC-SP 3, "Power Tool Cleaning."
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- H. Aluminum Substrates: Remove loose surface oxidation.
- I. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.

2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
  3. Use only thinners approved by paint manufacturer and only within recommended limits.
- J. Drywall: Fill any cracks or defects with drywall joint compound. Sand any rough spots smooth. Do not raise nap on paper covering.

### 3.3 APPLICATION

- A. General: Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual." Paint/stain exposed surfaces, except where schedules indicate that a surface or material is not to be painted/stained or is to remain natural. If schedules do not specifically mention an item or surface to be painted, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.
1. Use applicators and techniques suited for paint and substrate indicated.
  2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
  3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
  4. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
  7. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
  8. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convactor covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
  9. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
    - a. Prefinished items include the following factory-finished components:
      - 1) Stainless steel items.
      - 2) Finished mechanical and electrical equipment.
      - 3) Light fixtures.
      - 4) Distribution cabinets.



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- b. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
  1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
  2. Omit primer on metal surfaces that have been shop primed and touchup painted.
  3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
  4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- E. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions and recommendations in "MPI Manual."
  1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
  2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
  3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.
- F. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- G. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed

surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

- H. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- I. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
  - 1. Provide satin finish for final coats.
- J. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
- L. Painting Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work: Paint the following work where exposed to view at applications indicated:
  - 1. Equipment rooms:
    - a. Equipment, including panelboards.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.
  - 2. Occupied areas:
    - a. Interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
    - b. Other items as directed by Owner.
  - 3. Exterior locations:
    - a. Equipment, including panelboards.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.

### 3.4 CLEANING AND PROTECTION

- A. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

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- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
- E. Correction of Defective Work:
  - 1. Repair abraded, damaged or incomplete paint surfaces by methods acceptable to Architect. Spot repairs to be well-blended into adjacent work. For large repairs, re-coat entire plane or building element in which damaged area occurs.
  - 2. Defaced surfaces of work not to be painted shall be cleaned and their original finish restored.
- F. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 PAINT SYSTEMS

(Interior and exterior paint systems are on the following pages)

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A. Interior Paint Systems:

SURFACE		PAINT SYSTEM		COATS	MANUFACTURER'S DESIGNATION	
(1)	Gypsum Drywall	P12.A	Flat, Latex	First Coat	061	Pigmented PVA Sealer Aqua Seal Majestic Majestic
				Second Coat	015	
				Third Coat	015	
	P12.B	Semi-Gloss Latex	First Coat	061	Pigmented PVA Sealer Aqua Seal Mirro Glide SG Mirro Glide SG	
Second Coat			124			
Third Coat			124			
P12.C	Eggshell Enamel Latex	First Coat	061	Pigmented PVA Sealer Aqua Seal Lo Glo Lo Glo		
		Second Coat	022			
		Third Coat	022			
(Textured)	P12.D	Flat	One Coat	019	Luxwall RTU	
(3)	Ferrous Metal	P14.A	Flat Latex	First Coat	561	Acrylic Metal Prime Majestic Majestic
				Second Coat	015	
				Third Coat	015	
P14.B	Semi-Gloss Latex	First Coat	561	Acrylic Metal Prime Mirro Glide SG Mirro Glide SG		
		Second Coat	124			
		Third Coat	124			
P14.C	Eggshell Latex	First Coat	561	Acrylic Metal Prime Lo Glo Lo Glo		
		Second Coat	022			
		Third Coat	022			
(4)	Galvanized Metal/ Aluminum	P15.A	Flat Latex	First Coat	561	Acrylic Metal Prime Majestic Majestic
				Second Coat	015	
				Third Coat	015	
P15.B	Semi-Gloss Latex	First Coat	561	Acrylic Metal Prime Mirro Glide SG Mirro Glide SG		
		Second Coat	124			
		Third Coat	124			
P15.C	Eggshell Latex	First Coat	561	Acrylic Metal Prime Lo Glo Lo Glo		
		Second Coat	022			
		Third Coat	022			
(9)	Ceiling and Wall w/ misc. Pipes & Conduit Exposed, Trusses & Beams w/Spray-on Fire Insulation	P20.A		One Coat	504	Latex Dryfall White or Black

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SURFACE		PAINT SYSTEM		COATS	MANUFACTURER'S DESIGNATION	
(10)	Exposed Concrete Floor	P21.A	Water-base clear sealer H&C (Sherwin Williams)	First & Top Coats	50.043 054	Concrete & Masonry Waterproofing Sealer

B. Exterior Paint Systems:

SURFACE		PAINT SYSTEM		COATS	MANUFACTURER'S DESIGNATION	
(4)	Ferrous Metal	P55.D	Gloss, High Perform.	First Coat Second Coat Third Coat	--- --- ---	Amerlock 2 VOC Epoxy Amershield VOC Amershield VOC
		P55.E	Semi-Gloss High Perform.	First Coat Second Coat Third Coat	--- --- ---	Precision Coatings DTM1300 Precision Coatings PC3v100 Precision Coatings PC3v100
(5)	Galv. Metal & Aluminum	P56.A	Gloss	First Coat Second Coat Third Coat	561 143 143	Acrylic Metal Prime Mirro Glide GL Mirro Glide GL
		P56.B	Flat, Acrylic	First Coat Second Coat Third Coat	561 203 203	Acrylic Metal Prime Duratec II Duratec II
		P56.C	Semi-Gloss Enamel Acrylic	First Coat Second Coat Third Coat	561 124 124	Acrylic Metal Prime Mirro Glide SG Mirro Glide SG
		P56.D	Gloss	First Coat Second Coat Third Coat	561 146 146	Acrylic Metal Prime Arothane GL Arothane GL
		P56.E	Semi Gloss	First Coat Second Coat Third Coat	561 136 136	Acrylic Metal Prime Arothane S/G Arothane S/G

END OF SECTION

## **SECTION 09 97 57**

### **POLYETHYLENE TAPE PIPE COATING (AWWA C214)**

#### **PART 1 GENERAL**

##### *1.1 DESCRIPTION*

- A. This section describes materials, installation, and testing of a cold-applied polyethylene pipe coating complying with AWWA C209 and C214 with a cement mortar armor coat in accordance with AWWA C205 for pipe sizes 4 inches and larger.
- B. Supervisors of tape coating and cement mortar coating operations shall have at least two years' continuous recent experience in the application of tape and cement-mortar coating systems for steel pipe. The manufacturer of the tape coatings shall demonstrate a minimum of five years' successful application of this product on large diameter steel water pipelines.

##### *1.2 RELATED WORK SPECIFIED ELSEWHERE*

- A. Section 09 90 00 – Painting and Coating
- B. Section 31 23 00 – Earthwork
- C. Section 40 05 00 Pipe & Fittings

##### *1.3 SUBMITTALS*

- A. Submit shop drawings in accordance with General Provisions.
- B. As specified in Section 01 33 00 – Submittal Procedures
- C. Submit certificates of tests of physical and performance characteristics of each batch of primer and tape.
- D. Submit method approved by tape manufacturer to minimize voids at weld seams. Submit method approved by tape manufacturer to minimize disbondment of free ends of tape during shipping and storage.
- E. Submit application procedure approved by tape manufacturer, including the pattern of distribution and method of application of the weld seam tape system.
- F. Submit affidavit of compliance with the referenced standards (e.g., AWWA C209, C214, etc.).

- G. Submit schedule for application of tape coating. Schedule coating to be accomplished during normal working hours. Provide minimum two weeks' notice to the Construction Manager prior to commencing or rescheduling work.
- H. Submit the names and qualifications of the workers and supervisors to be employed on the coating operation a minimum of 14 days prior to the start of taping operations.

#### 1.4 INSPECTION

- A. The entire procedure of applying the protective coating material as herein described will be inspected by the Construction Manager from surface preparation to completion of coating. Such inspection shall not relieve the Contractor of responsibility to furnish material and perform work in accordance with this specification. All coating work shall be done in the presence of the Construction Manager. Coating work not done in the Construction Manager's presence will be subject to rejection.

## PART 2 MATERIALS

### 2.1 POLYETHYLENE TAPE COATING

- A. Polyethylene tape coating shall be in accordance with AWWA C214 as modified herein. The entire taping operation shall be developed by the pipe manufacturer with the assistance from and approval of the tape manufacturer. Inner layer and outer layer polyethylene tape shall exhibit properties meeting the requirements of AWWA C214. The total coating system shall be the Polyken YGIII System, Alta 100.20 Innerlayer/206.30 Outerlayer System, or equal. The application shall consist of one inner layer and one outer layer with the inner layer tape of thickness 20 mils minimum and the outer layer tape of thickness 35 mils minimum each. The total coating thickness shall not be less than 55 mils measured in the unapplied state and shall exhibit the properties meeting the requirements of AWWA C214, Table 4. Tape width shall not exceed 12 inches regardless of pipe diameter.
- B. Polyethylene tape coating for fittings and specials shall be three layers of 30-mil or two layers of 50-mil Type I or Type II in accordance with AWWA C209. The tape applied to fittings shall be compatible with the polyethylene tape coating system applied to pipe. Width of tape used shall be selected on the basis of the geometry of the particular fitting or special being coated. Alternatively, coat fittings and specials with two layers of half lapped 50-mil hot-applied coal-tar tape in accordance with AWWA C203. Total thickness shall be 100 mils in the unapplied state. Prepare and coat weld seams as specified for normal straight pipe.

### 2.2 TAPE MATERIALS

- A. Tape materials shall conform to the following criteria:
  - 1. Inner Layer Tape:

Polyethylene Tape Pipe Coating (AWWA C214)  
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Backing	98% blend of high- and low-density polyethylene with the remaining portion a blend of colorants and stabilizers.
Adhesive	100% butyl-based elastomers with resins for adhesion, cathodic disbonding, and long-term in- ground performance.
Tensile strength at break	30 lb/in. per ASTM D1000
Elongation at break	200% per ASTM D1000
Adhesion to steel	100 oz/in. width per ASTM D1000
Adhesion to primed steel	300 oz/in. width per ASTM D1000
Adhesion to backing	40 oz/in. width per ASTM D1000
Dielectric strength	Greater than or equal to 20 kV per ASTM D149
Insulation resistance	$1 \times 10^{12}$ ohms per ASTM D1000
Water vapor transmission rate	<0.2 gm/100 sq. in./24 hours at 70°F per ASTM E96, Method B
Cathodic disbonding at 20°C (68°F) for 30 days	0.2 sq. in. per ASTM G8
Shear resistance at 66°C (150°F) for four weeks	0.2 mm/day per ASTM D3654, Procedure A
Hydrolytic stability for 200 hours at 98°C H <sub>2</sub> O, adhesion > 150 oz/in.	
Thermal stability for 2,000 hours at 100°C air, adhesion > 150 oz/in.	

2. Outer Layer Tape:

Backing	96% blend of high- and low-density polyethylene with the remaining portion a blend of colorants and stabilizers.
Adhesive	100% butyl-based elastomer with resins for adhesion, cathodic disbonding, and long-term

Polyethylene Tape Pipe Coating (AWWA C214)  
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	in-ground performance.
Tensile strength	45 lb/in. width (inner wrap) per ASTM D1000
Tensile strength	55 lb/in. width (outer wrap) per ASTM D1000
Elongation	200% per ASTM D1000
Adhesion to steel	80 oz/in. width per ASTM D1000
Adhesion to backing	40 oz/in. width (inner wrap) per ASTM D1000
Adhesion to backing	60 oz/in. width (outer wrap) per ASTM D1000
Water vapor transmission	<0.2 gm/100 sq. in./24 hours at 70°F per ASTM E96, Method B
Dielectric strength	Greater than or equal to 25 kV per ASTM D149
Second mechanical outer layer shall have UV protection.	

### PART 3 EXECUTION

#### 3.1 PIPE PREPARATION

- A. Perform the entire coating operation as a one-station operation where the pipe is supported at the ends in a manner that will permit the application of the specified coatings. No additional handling following the initial setup of the pipe section, from application of primer, tape coating, and cement-mortar coating, will be allowed. No application involving rollers to support the pipe during the primer application, plastic tape application will be permitted.
- B. The pipe shall be of sufficient stiffness or have sufficient internal bracing to keep pipe cylindrical during taping. Maintain the axis of pipe during application without rocking, pitching, or yawing.
- C. Perform the coating operation in an environmentally controlled area such that it is protected from direct sunlight, wind, rain, snow, mist, fog, dust, and hail.
- D. Remove welding slag or scale by wire brushing, hammering, or other means prior to priming. Completely remove corrosion and foreign substances from the exterior of the pipe by blasting. The blast profile depth shall not exceed 3 mils. Wipe and broom the pipe surface after sandblasting and transport to coating station to remove grit, dust, and foreign substances.
- E. Prepare the exterior weld bead as follows:

Polyethylene Tape Pipe Coating (AWWA C214)  
 09 97 57-4

1. Where the exterior weld bead has a rough or irregular surface or narrow profile or is in excess of 1/16 inch in height, remove the exterior weld bead along the entire exterior surface of the pipe. The exterior weld bead shall be flush with the exterior surface of the pipe with a tolerance of +1/64 inch. Remove the weld bead such that no gouging or nicking of the plate surface will occur. This operation shall result in a smooth exterior surface with no ridges or valleys that may allow bridging or disbonding of the tape from the surface of the pipe.
  2. Where the exterior weld bead has a smooth surface and broad profile and is not in excess of 1/16 inch in height, remove the exterior weld bead within 18 inches of the ends of the pipe. The resultant bead shall be flush with the exterior surface of the pipe with a tolerance of +1/64 inch. Remove the weld bead such that no gouging or nicking of the plate surface will occur. Apply primer as specified hereinafter, then prior to application of the inner wrap, apply a thin 6-inch-wide weld seam tape by automatic means over the weld seam. Construct the weld stripping tape of a low-density plastic backing not more than 5 mils thick and soft adhesive not more than 20 mils thick (Polyken 932-25 or equal). Immediately upon application, mechanically press the tape into place with a pressure roller to eliminate voids, wrinkles, or bubbles. Tape width shall extend 2 inches beyond the weld bead in each direction and shall be centered on the weld bead.
- F. Where pipe is shop cement-mortar lined, apply the exterior coating after the pipe is lined with mortar and the mortar is cured.
- G. Surface temperature of pipe shall be uniform, between degree Fahrenheit and 100 degree Fahrenheit, and greater than 5 degree Fahrenheit above the dew point.

### 3.2 APPLICATION OF PRIMER

- A. Uniformly heat primer to maintain at 70 degree Fahrenheit  $\pm$ 10 degree Fahrenheit (or slightly above pipe surface temperature when greater than 70 degree Fahrenheit), throughout the application procedure. Use continuous recording chart-type devices to monitor primer temperature. Thoroughly mix the primer and agitate continuously during application to prevent settling of solids.
- B. Wipe the pipe surface free of dust and grit. Apply the primer coating immediately after surface preparation. Apply primer by automatic means with the spray shielded from drafts to result in a uniform thin primer over the entire pipe surface. Primer coverage shall be in accordance with manufacturer's recommendations but shall not exceed 600 square feet per gallon.
- C. Remove any imperfections from priming such as foreign material, drips, and runs. Reprime at location of such imperfections. Primer shall be sufficiently tacky prior to tape application to result in a void-free bond to steel.
- D. Thoroughly mix and heat primer, if necessary, to apply at optimum temperature.

### 3.3 *TAPE APPLICATION*

- A. The entire coating operation shall be performed by experienced workers skilled in the application of prefabricated cold-applied tape wrap coating and cement-mortar coating under qualified supervisors.
- B. Apply pipeline tape at a uniform roll body temperature above 50 degree Fahrenheit and at an ambient temperature above 30 degree Fahrenheit. Store up to the time of application under such conditions and for a sufficient period of time that the roll body temperature shall be within the temperature range recommended by the tape system manufacturer at the time of application.
- C. Prime and hand press the free ends of outer wrap of each pipe section into place. Immediately upon application, mechanically press the inner layer tape into place by means of coating equipment with constant tension tape dispensing machines to result in a void-free coating, bonded to the primed steel surface and weld seam tape system. Spirally apply the inner layer tape with a 1-inch-minimum overlap, incorporating a pressure roller wider than the tape width to provide maximum contact at the step-down of the overlap and to eliminate air entrapment between the tape and the pipe. The pressure roller shall be hard rubber applying 1,000 to 1,200 psi against the pipe exactly at the tape-to-pipe contact.
- D. Operators shall make adjustments, including spindle-brake tension adjustments, to provide a continuous, uniform, tight coating. Apply tape at a uniform rate throughout the entire length of pipe at a tape speed not in excess of 3 fps. A smooth, taut coating accomplished with a tape-width drawdown not in excess of 2 percent shall be considered adequate. Keep wrinkles, puckers, and voids to a minimum and maintain the specified lap.
- E. Simultaneously with tape application, apply the specified outer wraps spirally. Make necessary adjustments to achieve a uniform, tightly applied outer wrap, essentially free of wrinkles, puckers, and voids, with a 1-inch-minimum lap width. Continuously record tape temperature near the point of application, and provide automatic means to adjust tape temperature during application.
- F. When solvent is used to remove coating or primer prior to welding, none of it shall be permitted to contact the exposed tape adhesive. Precautions shall be taken to protect the exposed tape, and only solvents approved by the tape manufacturer shall be used.
- G. Hold back the tape coating a sufficient length to provide clearance for welding joints in the field.

### 3.4 *CEMENT MORTAR ARMOR COATING*

- A. Apply a 1-inch-thick reinforced cement mortar armor coating over the tested and holiday-free completed tape coating, in accordance with AWWA C205. The cement mortar shall consist of not more than 4.5 cubic feet of sand to one sack (94 lbs) of cement.

- B. Leave 3 inches of tape uncoated at each end of the pipe in order to facilitate field tape coating of the joints.

### 3.5 COATING OF WELDED FIELD JOINTS

- A. When the joints are bell-and-spigot (weld bell) for field welding and the drawings or specifications do not require a full fillet weld or when the welding is accomplished from the inside only, apply a moldable filler material (per Section Section 09 90 00 – Painting and Coating) to fill all voids at the step down prior to tape coating the joint. Place the filler material firmly against the primed steel surfaces to eliminate voids under the tape and provide a smooth transition surface between bell and spigot.
- B. Complete the coating of the joint in accordance with Section 09 90 00 – Painting and Coating, then after successful holiday testing of the joint, apply mortar coating over the joint in accordance with AWWA C205.

### 3.6 MECHANICAL COUPLINGS AND PIPE ENDS

- A. Where rubber-gasketed joints or mechanical couplings are used, apply a moldable filler material as specified for field-welded joints to fill all surface irregularities prior to application of tape. Alternatively for mechanical couplings, apply petrolatum or petroleum wax tape coating in accordance with AWWA C217.

**END OF SECTION**

## SECTION 10 14 00

### SIGNAGE

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Interior panel signs for room or space identification.
- B. Related Sections:
  - 1. Division 22, 23, and 26 Sections as applicable to Plumbing, Mechanical, and Electrical Work for tags and nameplates.

##### 1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data including construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.
- B. Shop Drawings: Include plans, elevations, and full-scale template layout of characters and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.
- C. Schedule: Schedule indicating sign locations, type, other pertinent data, and referenced to rooms or doors with the same referencing as used on the Drawings.
- D. Braille Text Translation Confirmation: Provide confirmation of Braille text translations.
- E. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

##### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each sign type through one source from a single manufacturer.

## 1.5 PROJECT CONDITIONS

- A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions by field measurement before fabrication and indicate measurements on Shop Drawings.

## 1.6 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to replace signs that fail in materials or workmanship within specified warranty period.
  - 1. Damage from deliberate destruction and vandalism is excluded.
  - 2. Warranty Period for Interior Signs: Building lifetime.

## PART 2 - PRODUCTS

### 2.1 REGULATORY REQUIREMENTS FOR SIGNAGE

- A. Regulatory Requirements: Comply with requirements of the 2010 ADA Standards for Accessible Design and the 2010 California Building Code (August 1, 2012 Supplement), and ANSI A117.1.
- B. Sign Types (CBC 117B.5.1):
  - 1. (CBC 1117B.5.1, Item 1) Identifications Signs: Where signs identify permanent rooms or spaces of a building or site, including tactile exit signs, they shall comply with the requirements of CBC Sections 1117B.5.2, 1117B.5.3, 1117B.5.5, and 1117B.5.6.
  - 2. (CBC 1117B.5.1, Item 2) Directional and Informational Signs: Where signs direct to or give information about permanent rooms and functional spaces of a building or site, they shall comply with the requirements of CBC Sections 1117B.5.2, 1117B.5.3, and 1117B.5.4.
  - 3. (CBC 1117B.5.1, Item 3) Accessibility Signs: Where signs identify, direct to or give information about accessible elements and features of a building or site, they shall include the appropriate symbol of accessibility and shall comply with the requirements of CBC Sections 1117B.5.2, and 1117B.5.8.
- C. Requirements for Signs:
  - 1. (CBC 1117B.5.2) Sign Finish and Contrast: Characters, symbols, and their background shall have a non-glare finish. Characters and symbols shall contrast with their background, either light on dark background or dark on light background. Requirement applies to all signs.
  - 2. (CBC 1117B.5.3) Proportions: Visual characters (Text and/or numbers) on signs shall be selected from fonts where the width of the uppercase letter "O" is 60 percent minimum and 110 percent maximum of the height of the uppercase letter "I". Stroke thickness of the uppercase letter "I" shall be 10 percent minimum and

20 percent maximum of the height of the character. Requirement applies to permanent room identification signs, and directional and informational signs.

3. (CBC 1117B.5.4) Character Height: Characters (Text and/or numbers) on signs shall be sized according to the viewing distance from which they are to be read. The minimum height shall be measured using an uppercase letter "I"; lower case characters are permitted. Viewing distance shall be measured as the horizontal distance between the character and an obstruction preventing further approach towards the sign. Requirement applies to directional and informational signs. Minimum character height shall be as follows:
  - a. Signs Mounted 40 to 70 Inches above the Floor: 5/8 inch high characters for signs having a viewing distance less than 72 inches; for viewing distances equal to or greater than 72 inches, add 1/8 inch in character height for each twelve inches of viewing distance greater than 72 inches.
  - b. Signs Mounted over 70 Inches to 120 Inches above the Floor: 2 inch high characters for signs having a viewing distance less than 180 inches (15 feet); for viewing distances equal to or greater than 180 inches, add 1/8 inch in character height for each twelve inches of viewing distance greater than 180 inches.
  - c. Signs Mounted Over 120 Inches Above the Floor: 3 inch high characters for signs mounted greater than 120 inches above the floor having a viewing distance less than 21 feet; for viewing distances equal to or greater than 21 feet, add 1/8 inch in character height for each twelve inches of viewing distance greater than 21 feet.
4. (CBC 1117B.5.5) Raised Characters and Pictorial Symbol Signs: Comply with the following:
  - a. (CBC 1117B.5.5, Item 1) Character Type: Characters on signs shall be raised 1/32-inch minimum from the background and be sans serif uppercase characters accompanied by Grade 2 Braille complying with CBC Section 1117B.5.6.
  - b. (CBC 1117B.5.5, Item 2) Character Size: Raised characters shall be a minimum of 5/8-inch and a maximum of 2-inches high.
  - c. (CBC 1117B.5.5, Item 3) Pictorial Symbol Signs (Pictograms): Pictorial symbol signs (pictograms) shall be accompanied by an equivalent written description located directly below the pictogram. The outside dimension of the pictogram field shall be a minimum of 6 inches in height.
  - d. (CBC 1117B.5.5, Item 4) Character Placement: Characters and Braille shall be in a horizontal format. Braille shall be placed a minimum of 3/8 inch and a maximum of 1/2 inch directly below the tactile characters; flush left or centered. When tactile text is multi-lined, all Braille shall be placed together below all lines of tactile text.
  - e. (CBC 1117B.5.5, Item 5) Proportions: Raised characters (Text) on signs shall be selected from fonts where the width of the uppercase letter "O" is 60 percent minimum and 110 percent maximum of the height of the uppercase letter "I". Stroke thickness of the uppercase letter "I" shall be 15 percent maximum of the height of the character.
5. (CBC 1117B.5.6) Braille: Contracted Grade 2 Braille shall be used wherever Braille is required in other portions of these standards. Braille dots shall be 1/10 inches on center in each cell with 2/10 inch space between cells measured from

the second column of dots in the first cell to the first column of dots in the second cell. Braille dots shall be raised a minimum of 1/40 inch above the background. Braille dots shall be domed or rounded.

6. (CBC 1117B.5.7) Mounting Location and Height: Where permanent identification signs are provided for rooms and spaces, signs shall be installed on the wall adjacent to the latch side of the door. Where there is no wall space on the latch side, including at double leaf doors, signs shall be placed on the nearest adjacent wall, preferably on the right.
  - a. Where permanent identification signs are provided for rooms and spaces, signs shall be located on the approach side of the door as one enters the room or space. Signs that identify exits shall be located on the approach side of the door as one exits the room or space.
  - b. Mounting height of signs with raised characters and Braille shall be located 48 inches minimum above the finish floor or ground surface, measured from the baseline of the lowest line of Braille and 60 inches maximum above the finish floor or ground surface, measured from the baseline of the highest line of raised characters.
  - c. Mounting Location: Mounting location shall be determined so that a person may approach within 3 inches of signage without encountering protruding objects or standing within the swing of a door (CBC 1117B.5.7). Signs containing tactile characters shall be located so that a clear space of 18 by 18 inches minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degrees open (ADA 703.4.2).
  - d. (CBC 1115B.6) Toilet Room Door Signage: In addition to wall signage, toilet rooms shall be identified with geometric (triangle/circle) signage complying with CBC 1115B.6 centered on doors and mounted 60 inches above the finished floor.
    - 1) Geometric door signage shall not contain Braille text.
7. (CBC 1117B.5.8.1) International Symbol of Accessibility (ISA): The International Symbol of Accessibility (ISA) shall be the standard used to identify facilities that are accessible to and usable by persons with physical disabilities. Figure and proportions shall comply with CBC Figure 11B-6.
  - a. Color of Symbol: The international Symbol of Accessibility shall consist of a white figure on a blue background; the blue shall be equal to Color No. 15090 in Federal Standard 595B. Alternate colors subject to approval by the governing agency.

## 2.2 MANUFACTURERS

- A. Manufacturers, Basis-of-Design Products: In other Articles where named manufacturer's products are indicated, Drawings and Specifications are based on products manufactured by:
  1. Trimco.
    - a. Subject to compliance with requirements, provide the product indicated or comparable products by one of the following:



- 1) ASI-Modulex, Inc.
- 2) Best Sign Systems Inc.
- 3) Don-Jo Manufacturing.
- 4) Mohawk Sign Systems.

## 2.3 PANEL SIGNS

- A. General: Provide smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch measured diagonally from corner to corner complying with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
- B. Design Requirements: Panel signs shall comply with Part 2 Article "Regulatory Requirements for Signage."
- C. Scheduled Signs: Provide signs as indicated on Drawings and as scheduled in Part 3 Article "Sign Schedule."
- D. Panel Signs: Basis of Design: Trimco 500/700 Series signs complying with the following requirements:
  1. Material: Polystyrene plastic, 0.25-inch thick.
  2. Edge Condition: Square, eased.
  3. Corner Condition: Rounded to radius of 1/2 inch (except for triangle geometric signs).
  4. Text Font: ADA/CBC compliant, sans serif.
  5. Text Height: 5/8 inch unless otherwise indicated.
  6. Braille: ADA/CBC compliant.
  7. Mounting: Mechanical fasteners, except use tape where mounting to glass is required.
  8. Color: White text/graphics on blue background.

## 2.4 ACCESSORIES

- A. Mechanical Fasteners: Flat or oval Philips head screws in countersunk holes. Color match or paint heads to match sign background.
- B. Adhesives: As recommended by sign manufacturer and with a VOC content of 70 g/L or less for adhesives used inside the weatherproofing system and applied on-site when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Locate signs and accessories where indicated, using mounting methods of types described and in compliance with manufacturer's written instructions.
  - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.
  - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as pairs of doors, install signs on nearest adjacent wall. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door. Install wall signs centered 60-inches above the floor surface.
- B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using methods indicated below:
  - 1. Vinyl-Tape Mounting: Use double-sided foam tape to mount signs to smooth, nonporous surfaces that cannot be drilled or screwed. Do not use this method for vinyl-covered or rough surfaces.
  - 2. Silicone-Adhesive Mounting: Use liquid-silicone adhesive recommended in writing by sign manufacturer to attach signs to irregular, porous, or vinyl-covered surfaces. Use double-sided vinyl tape where recommended in writing by sign manufacturer to hold sign in place until adhesive has fully cured.
  - 3. Mechanical Fasteners: Use non-removable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
  - 4. Where panel signs are mounted on glass, provide matching plate on opposite side of glass to conceal mounting materials.

### 3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.
- B. Clean per manufacturer's recommendation prior to final inspection.

### 3.4 SIGN SCHEDULE

- A. Interior Room Identification Signs: Provide interior room identification signage adjacent to room doors as indicated and scheduled on the Drawings.
  - 1. Text Content: Identify rooms by number and name unless otherwise indicated. Room names and numbering shall comply with Owner's instructions (not Architect's referencing or numbering as indicated on the Drawings).
  - 2. Text Height: As indicated on Drawings and in compliance with referenced CBC and ADA requirements.
  - 3. Sign Size: As indicated on drawings.
- B. Tactile Exit Signs: Provide tactile exit signs at locations indicated on Drawings, as required to comply with regulatory requirements, and as follows:
  - 1. At each grade level exterior exit door, provide a tactile exit sign with text stating "EXIT".
  - 2. At each exit door to a corridor from room having illuminated exit signs, provide a tactile exit sign stating "EXIT ROUTE".
- C. Rest Room Identification Sign: Signage shall consist of door (CBC geometric shapes) and wall (ADA plaques) mounted signs to comply with regulatory requirements and as indicated on the Drawings.
- D. Exterior International Symbol of Accessibility (ISA) Signs: Provide ISA signage at exterior public access entrances to each building.
  - 1. Signs shall include an international symbol of accessibility graphic 5-inches square in size.

END OF SECTION

## SECTION 10 28 00

### TOILET, SHOWER & LOCKER ROOM ACCESSORIES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Toilet, shower and locker room accessories.
  - 2. Underlavatory piping guards.
- B. Related Sections:
  - 1. Division 8 Section “Mirrors” for unframed lavatory mirrors.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
  - 1. Construction details and dimensions.
  - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  - 3. Material and finish descriptions.
  - 4. Indicate features that will be included for Project.
  - 5. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated on Drawings.
  - 2. Identify products using designations indicated on Drawings.
- C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
- B. Regulatory Requirements: Toilet room accessories and mounting heights of accessories to be used by persons with disabilities shall comply with accessibility requirements of the 2010 ADA Standards for Accessible Design and the 2010 California Building Code, Chapter 11B, "Accessibility to Public Buildings, Public Accommodations, Commercial Buildings, and Publicly Funded Housing."
  - 1. The height from the floor to any operating mechanism or point of dispensing shall not exceed 40-inches.

#### 1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Coordinate backing for mounting accessories with wall framing.

#### 1.6 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 10 (ten) years from date of Substantial Completion as indicated in the Accessory schedule at the end of the Section.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304 with satin finish, unless otherwise indicated.
- B. Brass: ASTM B 19 flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel).
- D. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- E. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

## 2.2 UNDERLAVATORY PIPING GUARDS

- A. Underlavatory Guard:
  - 1. Basis-of-Design Product: Drawings and Specifications are based on the following:
    - a. Truebro, Inc., Lavguard2 series underlavatory guard.
      - 1) Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
        - a) Plumberex Specialty Products, Inc.
  - 2. Description: Antimicrobial, white molded-plastic underlavatory guard assemblies. Underlavatory guard assemblies shall cover waste piping and hot and cold water supply piping, allow service access without removing coverings, and shall prevent contact with hot surfaces and/or sharp objects.
  - 3. Locations: Provide underlavatory guard assemblies at all lavatories and/or sinks in all toilet rooms, and at sinks in cabinets/counter tops that are indicated to be accessible to persons in a wheel chair.

## 2.3 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

1. Accessories mounted on walls within toilet compartments or within 2 feet of water closets, lavatories, sinks, urinals, or similar plumbing fixtures shall be installed with penetration of wall finishes sealed to protect structural elements within walls from moisture. Sealant shall not be visible in the finished installation. Sealant shall be mildew resistant silicone sealant as specified in Division 7 Section “Joint Sealants.”
- B. Grab Bars: Install to withstand a downward load of at least 250 lb when tested according to method in ASTM F 446.

### 3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

### 3.3 ACCESSORY LOCATIONS

- A. General: Accessories shall be provided at locations indicated on drawings, for locations where accessories are not indicated, provide accessories as follows:
  1. Paper Towel Dispensers / Waste Receptacle Combination Unit: Provide one semi-recessed mounted paper towel dispenser / waste receptacle for each toilet room.
  2. Soap Dispensers: Provide one surface mounted soap dispenser for each sink or lavatory.
  3. Toilet Tissue Dispensers: Provide one surface mounted toilet tissue dispenser for each toilet; provide one semi-recessed toilet tissue dispenser at wheel chair accessible toilets.
  4. Seat Cover Dispensers: Provide one surface mounted seat cover dispenser for each toilet.
  5. Grab Bars: Provide grab bars on the walls to the rear and to the side of each wheel chair accessible toilet.
  6. Mop Holder: Provide one mop holder for each mop sink.
  7. Mirror: Provide one framed mirror for each single wall-hung lavatory. See Division 8 Section “Mirrors” for unframed mirrors at multi-lavatory counters.
  8. Privacy Curtains: Where indicated on drawings.

3.4 **CONTRACTOR FURNISHED AND INSTALLED ACCESSORIES** The following accessories shall be furnished and installed by the Contractor at locations specified and/or indicated on the Drawings:

Reference	Description
Mirror	Bobrick B-165 Series (24" x 36") Mirror, channel frame, 1/2 x 1/2 x 1/2 type 430 stainless steel, bright finish, mitered corners, 1/4-inch mirror glass (10 year warranty), concealed mounting with theft resistant locking device. (Note: Mirrors require 1-inch clearance all around for securing to concealed mounting bracket).
Soap Dispenser, wall mount	Bobrick B-2111 (Classic Series) Liquid soap dispenser, surface wall mounted, 40 oz. capacity, concealed mounting, projects 3-1/2 inch wall to push button.
Seat Cover Dispenser	Bobrick B-221 (Classic Series) Seat cover dispenser, surface mounted, capacity of 250 single or half fold toilet seat covers, fills from bottom.
Grab Bars for accessible water closets	Bobrick B-6806 x 42, B-6806 x 48 1-1/2 inch diameter, satin finish, concealed mounting with snap flange. At each wheelchair accessible water closet, provide one 48 inch grab bar at the side wall and one 42 inch grab bar at the wall behind the water closet.
Toilet Paper Dispenser, surface mount	Bobrick B-2888 (Classic Series) Toilet tissue dispenser, surface mounted (6-inch projection from wall), multi-roll, non-controlled delivery with theft resistant spindle, holds (2) 5.25 inch rolls, Flush tumbler lock.
Towel Dispenser	Bobrick B-262 (Classic Series) Paper towel dispenser, surface mounted (projects 4-inches from wall), tumbler lock at top of face of cabinet, 400 C-fold or 525 multi-fold towels, projects 4 inches from wall. Provide with optional "TowelMate™" (Bobrick No. 262-130).

END OF SECTION



## **SECTION 10 44 15**

### **FIRE EXTINGUISHERS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Portable fire extinguishers.

##### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
- B. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

##### **1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain fire extinguishers and fire-extinguisher cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

##### **1.5 COORDINATION**

- A. Coordinate blocking and backing for wall anchorage of brackets with wall framing.

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure of hydrostatic test according to NFPA 10.
    - b. Faulty operation of valves or release levers.
  - 2. Warranty Period: Six years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - 1. J. L. Industries, Inc.; a division of Activar Construction Products Group.
  - 2. Larsen's Manufacturing Company.
  - 3. Potter Roemer LLC.

### 2.2 PORTABLE FIRE EXTINGUISHERS

- A. Multipurpose Dry-Chemical Type in Steel Container: UL-rated, 2-A:10-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
  - 1. Provide at locations where fire extinguishers are indicated on drawings.
- B. Valves: Manufacturer's standard.
- C. Handles and Levers: Manufacturer's standard.
- D. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

### 2.3 FIRE EXTINGUISHER BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where fire extinguishers will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. General: Install fire extinguishers, and mounting brackets in locations indicated.
  - 1. Mounting Heights: Mount brackets so that the top of installed fire extinguishers will be 48 inches above the finished floor.

END OF SECTION

## SECTION 22 00 00

### GENERAL PLUMBING PROVISIONS

#### PART 1 - GENERAL

##### 1.1 GENERAL CONDITIONS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Divisions 01 Specification Sections, apply to this Section.

##### 1.2 CODES AND REGULATIONS

- A. All work and materials shall be in accordance with current rules and regulations of applicable codes. Nothing in these Drawings or Specifications is to be construed to permit work not conforming to these codes. Should the Drawings or Specifications call for material or methods of construction of a higher quality or standard than required by these codes, the Drawings and Specifications shall govern. Applicable codes and regulations include, but are not necessarily limited to, the following:

California Building Code	CCR Title 24, Part 2
California Electrical Code	CCR Title 24, Part 3
California Mechanical Code	CCR Title 24, Part 4
California Plumbing Code	CCR Title 24, Part 5
California Energy Code	CCR Title 24, Part 6
California Fire Code	CCR Title 24, Part 9
Local Codes	

##### 1.3 DEFINITIONS

- A. Provide: The term "provide" as used in these specifications or on the drawings shall mean furnish and install.
- B. Piping: The term "piping" as used in these specifications or on the drawings shall mean all pipe, fittings, valves, hangers, insulation, etc. as may be required for a complete and functional system.
- C. Ductwork: The terms "duct" or "ductwork" as used in these specifications or on the drawings shall mean all ducts, fittings, joints, dampers, hangers, insulation, etc. as may be required for a complete and functional system.
- D. Wiring: The term "wiring" as used in these specifications or on the drawings shall mean all wiring, conduit, boxes, connections, transformers, relays, switches etc. as may be required for a complete and functional system.

##### 1.4 PERMITS AND FEES

- A. The Contractor shall take out all permits and arrange for all tests in connection with

his work as required. All charges are to be included in the work.

## 1.5 COORDINATION OF WORK

- A. Examination: Before starting work, thoroughly examine existing and newly completed underlying and adjoining work and conditions on which the installation of this work depends. Report to the Engineer in writing all conditions which might adversely affect this work.
- B. Layout: Layout of materials, equipment and systems is generally diagrammatic unless specifically dimensioned. Some work may be shown offset for clarity. The actual locations of all materials, piping, ductwork, fixtures, equipment, supports, etc. shall be carefully planned prior to installation of any work in order to avoid all interference with each other, or with structural, electrical, architectural or other elements.
- C. Verification: If discrepancies are discovered between drawing and specification requirements, the more stringent requirement shall apply. All conflicts shall be called to the attention of the Engineer prior to the installation of any work or the ordering of any equipment. No work shall be prefabricated or installed prior to this coordination. No costs will be allowed to the Contractor for any prefabrication or installation performed prior to this coordination. Verify the proper voltage and phase of all equipment with the electrical plans.
- D. Location of Utilities Prior to Trenching or Earthwork: The Contractor shall notify the Owner a minimum of two business days prior to beginning trenching or earthwork. Prior to this notification, the Contractor shall have marked all proposed trenches with paint and shall have contacted a utility locating company and have had this company mark all found underground utilities with paint. The Contractor shall then coordinate and arrange for a site visit with the Owner to review the proposed trenching and/or earthwork areas. Trenching and/or earthwork shall not begin until the Owner agrees. Repair and/or compensation for repair of marked utilities is the responsibility of the Contractor. The Owner retains the right to either self-perform the repair or require the Contractor to complete the repair, as directed by the Owner. If while performing the work, the Contractor discovers utilities that have not been marked, the Contractor shall immediately notify the Owner verbally and in writing.

## 1.6 GUARANTEE

- A. Guarantee shall be in accordance with the General Conditions. The Contractor shall repair any defects due to faulty materials or workmanship and pay for any resulting damage to other work which appears within the guarantee period. These Specifications may extend the period of the guarantee for certain items. Where such extensions are called for, or where items are normally provided with guarantee periods in excess of that called for in the General Conditions, the certificate of guarantee shall be furnished to the Owner through the Engineer.

#### 1.7 QUIETNESS

- A. Piping, ductwork and equipment shall be arranged and supported so that vibration is a minimum and is not transmitted to the structure.

#### 1.8 DAMAGES BY LEAKS

- A. The Contractor shall be responsible for damages caused by leaks in the temporary or permanent piping systems prior to completion of work and during the period of the guarantee, and for damages caused by disconnected pipes or fittings, and the overflow of equipment prior to completion of the work.

#### 1.9 EXAMINATION OF SITE

- A. The Contractor shall examine the site, compare it with Plans and Specifications, and shall have satisfied himself as to the conditions under which the work is to be performed. No allowance shall subsequently be made in his behalf for any extra expense to which he may be put due to failure or neglect on his part to make such an examination.

#### 1.10 COMPATIBILITY WITH EXISTING SYSTEMS

- A. Any work which is done as an addition, expansion or remodel of an existing system shall be compatible with that system.

#### 1.11 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be new unless otherwise noted. Materials and equipment of a given type shall be by the same manufacturer. Materials and equipment shall be free of dents, scratches, marks, shipping tags and all defacing features at time of project acceptance. Materials and equipment shall be covered or otherwise protected during construction as required to maintain the material and equipment in new factory condition until project acceptance.

#### 1.12 SUBMITTALS

- A. Shop Drawings: Within 30 days of contract award, the Contractor shall submit six copies of shop drawings for all materials, equipment, etc. proposed for use on this project. Material or equipment shall not be ordered or installed until written review is processed by the Engineer.

All shop drawings must comply with the following:

1. Shop drawings are required for all material and equipment items and shall include manufacturer's name and catalog numbers, dimensions, capacities, performance curves, and all other characteristics and accessories as listed in the specifications or on the drawings. Descriptive literature shall be

current factory brochures and submittal sheets. Capacities shall be certified by the factory. FAX submittals are not acceptable.

2. All shop drawings shall be submitted at one time in a neat and orderly fashion in a suitable binder with title sheet including Project, Engineer and Contractor, table of contents, and indexed tabs dividing each group of materials or item of equipment. All items shall be identified by the specification paragraph number for which they are proposed. All equipment shall also be identified by the mark number as indicated on drawings.
  3. All capacities, characteristics, and accessories called for in the specifications or on the drawings shall be high-lighted, circled or underlined on the shop drawings. Calculations and other detailed data indicating how the item was selected shall be included for items that are not scheduled. Data must be complete enough to permit detailed comparison of every significant characteristic which is specified, scheduled or detailed.
- B. Substitutions: Manufacturers and model numbers listed in the specifications or on the drawings represent the standard of quality and features desired. Proposed substitutions shall comply with the Owner's General Requirements. Calculations and other detailed data indicating how the item was selected shall be included. The Contractor shall assume full responsibility that substituted items or procedures will meet the specifications and job requirements and shall be responsible for the cost of redesign and modifications to the work caused by these items. At the Engineer's request, furnish locations where equipment similar to the substituted equipment is installed and operating along with the user's phone numbers and contact person. Satisfactory operation and service history will be considered in the acceptance or rejection of the proposed substitution.
- C. Review: Submittals will be reviewed for general conformance with the design concept, but this review does not guarantee quantity shown, nor does it supersede the responsibility of the Contractor to provide all materials, equipment and installation in accordance with the drawings and specifications. The Contractor shall agree that shop drawing submittals processed by the Engineer are not Change Orders; that the purpose of shop drawing submittals by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use. The Contractor shall agree that if deviations, discrepancies or conflicts between shop drawings and design drawings and specifications are discovered either prior to or after shop drawing submittals are processed by the Engineer, the design drawings and specifications shall control and shall be followed. If a resubmittal is required, submit a complete copy of the Engineer's review letter requiring such with the resubmittal.

### 1.13 MANUFACTURER'S RECOMMENDATIONS

- A. All material, equipment, devices, etc., shall be installed in accordance with the

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recommendations of the manufacturer of the particular item. The Contractor shall be responsible for all installations contrary to the manufacturer's recommendations. The Contractor shall make all necessary changes and revisions to achieve such compliance. Manufacturer's installation instructions shall be delivered to and maintained at the job site through the construction of the project.

#### 1.14 SCHEDULING OF WORK

- A. All work shall be scheduled subject to the review of the Engineer and the Owner. No work shall interfere with the operation of the existing facilities on or adjacent to the site. The Contractor shall have at all times, as conditions permit, a sufficient force of workmen and quantity of materials to install the work contracted for as rapidly as possible consistent with good work, and shall cause no delay to other Contractors engaged upon this project or to the Owner. HVAC equipment and functions, whether existing or new, shall be maintained in operating condition whenever the facility is occupied, unless otherwise approved by the Owner.

#### 1.15 DEMOLITION

- A. Existing equipment, ducts, piping, etc. noted for removal shall be removed and delivered to the Owner at a location to be determined by the Owner. Those items determined by the Owner to be of no value shall become the property of the Contractor and shall be removed from the job site by the Contractor at the Contractor's expense. Existing piping, ducts, services, etc. requiring capping shall be capped below floors, behind walls, above ceilings or above roof unless otherwise noted. Where items are removed, patch the surfaces to match the existing surfaces.

#### 1.16 HAZARDOUS MATERIAL REMOVAL

- A. All hazardous material removal will be by the Owner. Hazardous material is to be removed before the work is started. If the Contractor discovers hazardous material which has not been removed, the Contractor shall immediately cease work in that area and promptly notify the Owner.

#### 1.17 OPENINGS, CUTTING AND PATCHING

- A. The locations and dimensions for openings through walls, floors, ceilings, foundations, footings, etc. required to accomplish the work under this Specification Division shall be provided under this Division. Except as noted below, the actual openings and the required cutting and patching shall be provided by other Divisions. Coring through existing concrete or masonry walls, floors, ceilings, foundations, footings, etc., and saw cutting of concrete floors or asphaltic concrete required to accomplish the work under this Specification Division shall be provided under this Division. Patching of these surfaces shall be provided by other Divisions. Cutting or coring shall not impair the strength of the structure. Any damage resulting from this work shall be repaired at the Contractor's expense to the satisfaction of the Engineer.



#### 1.18 EXCAVATION AND BACKFILL

- A. General: Barrel of pipe shall have uniform support on sand bed. Sand shall be free from clay or organic material, suitable for the purpose intended and shall be of such size that 90 percent to 100 percent will pass a No. 4 sieve and not more than 5 percent will pass a No. 200 sieve. Unless otherwise noted, minimum earth cover above top of pipe or tubing outside building walls shall be 24", not including base and paving in paved areas.
- B. Excavation: Width of trench at top of pipe shall be minimum of 16", plus the outside diameter of the pipe. Provide all shoring required by site conditions. Where over excavation occurs, provide compacted sand backfill to pipe bottom. Where groundwater is encountered, remove to keep excavation dry, using well points and pumps as required.
- C. Backfill:
  - 1. 6" Below, Around, and to 12" Above Pipe: Material shall be sand. Place carefully around and on top of pipe, taking care not to disturb piping, consolidate with vibrator.
  - 2. One Foot Above Pipe to Grade: Material shall be sandy or silty loam, free of lumps, laid in 6" layers, uniformly mixed to proper moisture and compacted to required density. If backfill is determined to be suitable and required compaction is demonstrated by laboratory test, water compaction in 6" layers may be used, subject to review by Engineer.
- D. Compaction: Compact to density of 95% within building and under walkways, driveways, traffic areas, paved areas, etc. and to 90% elsewhere. Demonstrate proper compaction by testing at top, bottom and one-half of the trench depth. Perform these tests at three locations per 100' of trench.

#### 1.19 CONTINUITY OF SERVICES

- A. Existing services and systems shall be maintained except for short intervals when connections are made. The Contractor shall be responsible for interruptions of services and shall repair damage done to any existing service caused by the work. If utilities not indicated on the drawings are uncovered during excavation, the Contractor shall notify the Engineer immediately.

#### 1.20 PROTECTIVE COATING FOR UNDERGROUND PIPING

- A. All ferrous pipe below grade (except cast iron) shall have a factory applied protective coating of extruded high density polyethylene, 35 to 70 mils total thickness, X-Tru-Coat, Scotchkote. All fittings and areas of damaged coating shall be covered with two layer double wrap of 10 mil polyvinyl tape to total thickness of 40 mils. John-Mansville. Protective coating shall be extended 6" above surrounding grade.

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## 1.21 ACCESS DOORS

- A. Provide access doors as required where equipment, piping, valves, ductwork, etc. are not otherwise accessible. Access doors shall match the wall or ceiling finish and fire rating as indicated on the Architectural drawings. 16-gage steel frame and 14-gage steel door with paintable finish, except in ceramic tile, where door shall be 16-gage stainless steel with satin finish. Continuous hinge. Deliver doors to the General Contractor for installation. Milcor. Unless otherwise noted, the minimum sizes shall be as follows:

1 valve up to 1-1/2"	12" x 12"
1 valve up to 3"	16" x 16"

## 1.22 CONCRETE ANCHORS

- A. Steel stud with expansion wedge requiring a drilled hole – powder driven anchors are not acceptable. Minimum spacing shall be 12 diameters center to center and 10 diameters center to edge of concrete. Maximum allowable stresses for tension and shear shall be 80% of the ICC Evaluation Service Report (ESR) values. Minimum concrete embedment shall be the nominal embedment listed in the ESR table. Hilti Kwik Bolt TZ.

## 1.23 EQUIPMENT ANCHORING AND OTHER SUPPORTS

- A. Mechanical systems (equipment, ductwork, piping, conduit, etc.) shall be anchored in accordance with the CBC. All systems mounted on concrete shall be secured with a concrete anchor at each mounting point. All air handlers shall be mounted on spring isolators. Secure base plate as indicated above. Attachment of equipment, ductwork, piping, conduit, etc. supported on curbs or platforms shall be made to the side of curbs and platforms, where possible. Where screws or lag bolts must be installed through the top of a sheet metal cap, the installation shall be as follows. Pre-drill pilot hole. Fill pilot hole with polyurethane sealant. Install screw or lag bolt with a flat washer and an EPDM washer adjacent to the sheet metal.

## 1.24 SUPPORTS AND SEISMIC RESTRAINTS

- A. Any structural element required to hang or support piping, ducts or equipment provided under this Division and not shown on other drawings shall be provided under this Division.
- B. Mechanical systems (equipment, ductwork, piping, etc.) shall be provided with supports and seismic restraints in accordance with the CBC. Submit anchorage calculations and details stamped and signed by a structural engineer registered in the State of California. Submit shop drawings showing location, type and detail of restraints. Submit manufacturer's data for restraints. Restraint system shall be

Mason West, Inc. (OSHPD OPM 0043-13).

#### 1.25 PAINTING

- A. Paint all black iron supports, hangers, anchors, etc. with two coats of rust resisting primer. Also paint all uninsulated black iron piping exposed to weather with two coats of rust resisting primer.

#### 1.26 ROOF PENETRATIONS AND PATCHING

- A. Whenever any part of the mechanical systems penetrates the roof or exterior wall, the openings shall be flashed and counter-flashed water tight with minimum 22 gauge galvanized sheet metal. Flashing shall extend not less than eight inches from the duct, pipe, or supporting member in all directions unless detailed otherwise. All roof penetrations and patching shall be in accordance with the recommendations of the National Roofing Contractor's Association and the Owner's roofing standards.

#### 1.27 SYSTEM IDENTIFICATION

- A. Above Grade Piping: Provide markers on piping which is either exposed or concealed in accessible spaces. For piping systems, other than drain and vent lines, indicate the fluid conveyed or its abbreviation, either by pre-printed markers or stenciled marking, and include arrows to show direction of flow. Pre-printed markers shall be the type that wrap completely around the pipe, requiring no other means of fastening such as tape, adhesive, etc. Comply with ANSI A13.1 for colors. Locate markers at ends of lines, near major branches and other interruptions including equipment in the line, where lines pass through floors, walls or ceilings or otherwise pass into inaccessible spaces, and at 50' maximum intervals along exposed portions of lines. Marking of short branches and repetitive branches for equipment connections is not required.
- B. Below Grade Piping: Bury a continuous, pre-printed, bright-colored, metallic ribbon marker capable of being located with a metal detector with each underground pipe. Locate directly over buried pipe, 6" to 8" below finished grade.
- C. Equipment: All equipment shall be identified with a plastic laminated, engraved nameplate which bears the unit mark number as indicated on the drawings (e.g. AC-4). Provide 1/2" high lettering - white on black background. Nameplates shall be permanently secured to the exterior of the unit.
- D. Valves: Provide brass valve tags with brass hooks or chains on all valves of each piping system, excluding check valves, valves within equipment, faucets, stops and shut-off valves at fixtures and other repetitive terminal units. Prepare and submit a tagged-valve schedule, listing each valve by tag number, location and piping service. Deliver to Owner through the Engineer.

#### 1.28 CLEANING

- A. Progressively and at completion of the job, the Contractor shall thoroughly clean all of his work, removing all debris, stain and marks resulting from his work. This includes but is not limited to building surfaces, piping, equipment and ductwork, inside and out. Surfaces shall be free of dirt, grease, labels, tags, tape, rust, and all foreign material.

#### 1.29 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Printed: Three copies of Operation and Maintenance Instructions and Wiring Diagrams for all equipment and parts list for all faucets, trim, valves, etc. shall be submitted to the Engineer. All instructions shall be clearly identified by marking them with the same designation as the equipment item to which they apply (e.g. AC-3). All Wiring Diagrams shall agree with reviewed Shop Drawings and indicate the exact field installation. All instructions shall be submitted at the same time and shall be bound in a suitable binder with tabs dividing each type of equipment (e.g. Pumps, Fans, Motors, etc.). Each binder shall be labeled indicating "Operating and Maintenance Instructions, Project Title, Contractor, Date" and shall have a Table of Contents listing all items included.
- B. Verbal: The Contractor shall verbally instruct the Owner's maintenance staff in the operation and maintenance of all equipment and systems. The controls contractor shall present that portion of the instructions that apply to the control system. The Engineer's office shall be notified 48 hours prior to this meeting.
- C. Acknowledgment: The Contractor shall prepare a letter indicating that all operation and maintenance instructions (printed and verbal) have been given to the Owner, to the Owner's satisfaction. This letter shall be acknowledged (signed) by the Owner and submitted to the Engineer.

#### 1.30 RECORD DRAWINGS

- A. The Contractor shall obtain one set of prints for the project, upon which a record of all construction changes shall be made. As the work progresses, the Contractor shall maintain a record of all deviations in the work from that indicated on the drawings. Final location of all underground work shall be recorded by depth from finished grade and by offset distance from permanent surface structures, i.e. building, curbs, walks. In addition, the water, gas, sewer, under floor duct, etc. within the building shall be recorded by offset distances from building walls. An electronic copy of the original drawings will be made available to the Contractor. The Contractor shall transfer the changes, notations, etc. from the marked-up prints to the electronic copy. The record drawings (marked-up prints, electronic drawings disc and a hard copy) shall be submitted to the Engineer for review.

#### 1.31 ACCEPTANCE TESTING

- A. The Contractor shall perform, document and submit all acceptance testing as required by California Code of Regulations, Title 24, Part 6.

END OF SECTION

## SECTION 22 00 50

### PLUMBING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Division.

##### 1.2 GENERAL MECHANICAL PROVISIONS

- A. The preceding General Mechanical Provisions shall form a part of this Division with the same force and effect as though repeated here.

##### 1.3 SCOPE

- A. Included: Provide all labor, materials and services necessary for complete, lawful and operating systems as shown or noted on the drawings or as specified here. The work includes, but is not necessarily limited to, the following:
  - 1. Sanitary sewer system.
  - 2. Domestic water system.
  - 3. Drain system (including condensate drain).
  - 4. All equipment as shown or noted on the drawings or as specified.

#### PART 2 - PRODUCTS

##### 2.1 PIPING MATERIALS

- A. Sanitary Sewer:
  - 1. Soil, Waste and Vent Piping: Inside Building and Within Five Feet of Building Walls: Standard weight coated cast iron pipe and fittings, CISPI 301, or hub end with rubber gaskets, ASTM A74, ASTM C564. All cast iron pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute as manufactured by Tyler, AB&I or Charlotte. Heavy-duty shielded couplings, Type 304 stainless steel, with neoprene gasket, ASTM C1540. Husky HD 2000, Clamp-All 80. Mission HeavyWeight MG Couplings are also acceptable. Size 2" and smaller

above grade may be standard weight galvanized steel, ASTM A120/A53, with coated cast iron recessed drainage fittings, ANSI B16.12. 2" and smaller exposed to view shall be galvanized steel, ASTM A120/A53, with coated cast iron recessed drainage fittings, ANSI B16.12.

2. Cleanouts: Comparable models of Josam, Wade or Zurn are acceptable. Floor Cleanouts: Smith 4028 with nickel bronze top in finished areas; Smith 4228 in utility areas. Wall Cleanouts: Smith 4532 with stainless steel cover and screw. Pipe Cleanouts: Iron body with threaded brass plug.
3. Cleanout Box: Precast reinforced concrete. Cast iron lid marked for service. Christy F22 in foot traffic areas; G5 in roadways.

B. Storm Drain (Including Rain Water Leader, RWL):

1. Piping: Inside Building and Within Five Feet of Building Walls: Same as Soil, Waste and Vent Piping, except as otherwise noted on drawings. Where exposed to view on exterior of building, piping shall be galvanized steel with recessed drainage fittings.

C. Domestic Water:

1. Cold Water Piping:

a. Inside Building, Within Five Feet of Building Walls, and All Above Grade:

- 1) Schedule 40 galvanized steel pipe, ASTM A120/A53. 150 psi galvanized malleable iron screwed fittings, ANSI B16.3.

-or-

- 2) Hard temper seamless copper, ASTM B88. Wrought copper fittings, ANSI B16.22. Type L with brazed joints (1100F, min.). 1-1/2" and smaller above grade may be soldered, 95-5 tin-antimony solder. All nipples shall be red brass (85% copper). Above grade fittings may be copper (1/2" to 2") or bronze (2-1/2" to 4") press fittings, ASME B16.18 or ASME B16.22. EPDM O-rings. Installation shall be in accordance with the manufacturer's installation instructions. Nibco, ProPress.

b. Outside Building - Below Grade:

- 1) Same as Inside Building. Galvanized steel shall have protective coating.

-or-

- 2) 3" and Smaller: Schedule 40 Polyvinyl chloride (PVC) with solvent weld fittings where approved by administrative authority.

2. Hot Water Piping:
    - a. Inside Building - Above Slab: Same as Cold Water Piping - Inside Building.
  3. Valves and Specialties:
    - a. Valves:
      - 1) General: Manufacturer's model numbers are listed to complete description. Equivalent models of Crane, Grinnell, Milwaukee, Nibco, Stockham or Walworth are acceptable. All valves of a particular type or for a particular service shall be by the same manufacturer. Use full port ball valve for 2" and smaller water shutoff valves; see specification below.
      - 2) Gate Valve: 2" and Smaller: Lead Free. All bronze. Rising stem. Union bonnet. Wedge disk. Malleable iron handwheel. 200 psi WOG.
      - 3) Ball Valve: Full port. Lead Free. Bronze body, cap, stem, disk and ball. Screwed connection. Lever handle. TFE seat. O-ring seals. 300 psi WOG. Apollo, Grinnell, Jomar. .
    - c. Miscellaneous Specialties:
      - 1) Union: 2" and Smaller: AAR malleable iron, bronze to iron ground seat. 300 psi. Grinnell. Size 2-1/2" and Larger: Grooved pipe, synthetic gasket, malleable iron housing. Victaulic Style 77, Type "E" gasket, Grinnell.
      - 2) Dielectric Coupling: Insulating union or flange rated for 250 psig. EPCO.
      - 3) Shock Absorber: Multiple bellows. Seamless copper chamber approved for concealed installations. Designed and applied in accordance with PDI WH201. Sioux Chief, Watts.
- D. Drain Piping (including Condensate): Same as inside building cold water piping.
- E. Miscellaneous Piping Items:
1. Pipe Support:
    - a. Pipe Hanger: Steel "J" hanger with side bolt for piping 4" and smaller; steel clevis hanger for piping 5" and larger. Load and jam nuts. Size and maximum load per manufacturer's recommendation. Felt liner for copper piping. Hanger and rod shall have galvanized



finish. B-Line, Grinnell, Unistrut.

- b. Isolating Shield: Galvanized steel shell and reinforcing ribs. 1/4" non-conducting hair felt pad. Pipe hanger in accordance with paragraph above. Increase hanger size per manufacturer's recommendation. B-Line, Semco, Superstrut.
  - c. Construction Channel: 12-gage, 1-5/8" x 1-5/8" galvanized steel channel. Single or multiple section. Self-locking nuts and fittings. B-Line, Grinnell, Unistrut.
2. Flashing: Vent flashing shall be 4 lb/ft<sup>2</sup> lead, 16" sq. flange, length sufficient to be turned down 2" into vent. Oatey. Flashing for other piping through roof shall be prefabricated galvanized steel roof jacks with 16" sq. flange. Provide clamp-on storm collar and seal water tight with mastic.

## 2.2 PIPING INSULATION MATERIALS

- A. General: All piping insulation materials shall have fire and smoke hazard ratings as tested under ASTM E-84 and UL 723 not exceeding a flame spread of 25 and smoke developed of 50.
- B. Pre-Molded Fiberglass: Heavy density sectional pre-molded fiberglass with vapor barrier laminated all service jacket and pressure sealing vapor barrier lap. Thermal conductivity shall not exceed 0.25 Btu-in/hr-ft<sup>2</sup>-F at a mean temperature of 50F. Perm rating 0.02, ASTM E96. Puncture rating 50 Beach units, ASTM D781. Provide 3" (min.) wide tape of same material as lap for butt joints. For hot water piping, thickness shall be 1" for pipe sizes 1" and less; 1-1/2" thickness for pipe sizes 1-1/4" and larger. Certainteed, Knauf, Johns-Manville, Owens-Corning.
- C. PVC Jacket (for pipe, fittings and valves): Pre-molded polyvinyl chloride (PVC) jackets, 0.020" thickness. Size to match application. Provide solvent weld adhesive and PVC vapor barrier pressure sealing tape by same manufacturer. Zeston.
- D. Vapor Barrier Coating: Childers CP-30, Foster 30-25.
- E. Lagging Adhesive: Childers CP-50A, Foster 30-36.
- F. Outdoor Mastic: Childers CP-21, Foster 65-05.
- G. Insulating Tape: Ground virgin cork and synthetic elastomeric. Black, odorless, and non-toxic. K factor 0.43 Btu-in/hr-ft<sup>2</sup>-F or less. Non-shrinking. For outdoor use, provide protective finish by same manufacturer. Halstead.
- H. Molded Closed Cell Vinyl (Piping Insulation Under Disabled Accessible Lavatories and Sinks): Fully molded closed cell vinyl, 3/16" thick. Internal ribs on drain insulation to provide air gap. Thermal conductivity shall not exceed 1.17 BTU-in/hr-ft<sup>2</sup>-°F at an average temperature of 73°F. Weep hole in cleanout nut enclosure. Out of sight nylon fastening system. Hinged cap over valve to allow access for

servicing. Truebro Lav-guard.

## 2.3 FIXTURES

- A. General: Provide rough-in for and install all plumbing fixtures shown on drawings. Except in equipment rooms, all trim, valves and piping not concealed in wall structure, above ceiling or below floors, shall be brass with polished chrome plate finish, unless noted otherwise. All enameled fixtures shall be acid resisting. Standard color is white unless otherwise noted.
- B. Schedule: Refer to Plumbing Fixture Schedule on the drawings for list of fixtures and trim. Manufacturer's model numbers are listed to complete description. Equivalent models of American Standard, Eljer, Elkay, Haws, Kohler or T&S Brass are acceptable. For drainage fixtures, equivalent models of Josam, Smith or Zurn are acceptable.
- C. Stops and P-Traps: All fixtures shall be provided with stops and P-Traps as applicable. Wall mounted faucets, valves, etc. shall have integral stops or wall mounted stops.
  - 1. Stops: All hot and cold water supplies shall be 1/2" I.P.S. inlet angle stops with stuffing box, loose key lock shield, and brass riser (3/8" for 2-1/2 gpm and less, otherwise 1/2"). McGuire, Speedway.
  - 2. P-Traps: Semi-cast brass, ground joint. 17-gage. Clean-out plug. Unobstructed waterway. California Tubular, McGuire.

## 2.4 EQUIPMENT

- A. General Requirements:
  - 1. Capacity: Capacities shall be in accordance with schedules shown on drawings. Capacities are to be considered minimum.
  - 2. Dimensions: Equipment must conform to space requirements and limitations as indicated on drawings and as required for operation and maintenance. Equipment will not be accepted that does not readily conform to space conditions. Prepare and submit layout drawings for all proposed equipment (different than scheduled units) showing actual job conditions, required clearances for proper operation, maintenance, etc.
  - 3. Ratings: Electrical: Electrical equipment shall be in accordance with NEMA standards and UL or ETL listed where applicable standards have been established.
  - 4. Piping: Each item or assembly of items shall be furnished completely piped

for connection to services. Control valves and devices shall be provided. Equipment requiring domestic water for non-potable use shall be provided with backflow preventer acceptable for intended use by local governing authorities.

5. Electrical:

- a. General: Each item or assembly of items shall be furnished completely wired to individual terminal blocks for connection to single branch electrical circuit. All electrical accessories and controls required by equipment shall be furnished. Provide terminal blocks for controls and interlocks not included in equipment package. Controllers and other devices shall be in NEMA 1 or 3R enclosures as applicable.
  - b. Wiring: Conductors, conduit, and wiring shall be in accordance with Electrical Specifications. Individual items within assembly shall be separately protected with dead front, fused disconnect, fuse block, or circuit breaker for each ungrounded conductor, all accessible on operating side of equipment. Switches, contacts and other devices shall be in ungrounded conductors.
  - c. Submittals: Included in shop drawings shall be internal wiring diagrams and manufacturer's recommended external wiring.
- B. Water Heater: Electric. Tankless point-of-use instant hot water heater. Cast aluminum housing, celcon waterways and nichrome coils. Maximum 150 psi rating. UL listed. Chromomite, Eemax.

## PART 3 - EXECUTION

### 3.1 PIPING INSTALLATION

A. General:

1. Piping Layout: Piping shall be concealed in walls, above the ceilings, or below grade unless otherwise noted. Exposed piping shall run parallel to room surfaces; location to be approved by the Engineer. No structural member shall be weakened by cutting, notching, boring or otherwise, unless specifically allowed by structural drawings and/or specifications. Where such cutting is required, reinforcement shall be provided as specified or detailed. All piping shall be installed in a manner to ensure unrestricted flow, eliminate air pockets, prevent any unusual noise, and permit complete drainage of the system. All piping shall be installed to permit expansion and contraction without strain on piping or equipment. Vertical lines shall be installed to allow for building settlement without damage to piping. Pipe sizes indicated on the drawings are nominal sizes

unless otherwise noted. Provide secondary drain piping where required.

2. Joints:

- a. Threaded: Pipe shall be cut square and reamed to full size. Threads shall be in accordance with ANSI B2.1. Joint compound or tape suitable for conveyed fluid shall be applied to male thread only. Joints shall be made with three threads exposed.
- b. Welded or Brazed: Filler rod shall be of suitable or the same alloy as pipe. Brazing filler metal shall have a minimum melting point of 1100F. Welding or brazing shall be performed by a Certified Welder or Brazer as certified by an organization/institution that uses standards recognized by the American Welding Society (AWS) and meets the requirements of the ASME Boiler and Pressure Vessels Code, Section 9.
- c. Open Ends: Open ends of piping shall be capped during progress of work to preclude foreign matter.
- d. Electrical Equipment: Piping shall not be run over electrical panels, motor control centers or switchboards.

3. Fittings and Valves:

- a. Standard Fittings: All joints and changes in direction shall be made with standard fittings. Close nipples shall not be used.
- b. Reducers: Pipe size reduction shall be made with bell reducer fittings. Bushings shall not be used.
- c. Unions: A union shall be installed on the leaving side of each valve, at all sides of automatic valves, at equipment connections, and elsewhere as necessary for assembly or disassembly of piping.
- d. Valves: All valves shall be full line size. Provide shut-off valve for each building and each equipment connection. Provide shut-off valve at each point of connection to existing piping. At equipment connections, valves shall be full size of upstream piping, except that gas valves within 18" of the point of connection to the equipment may be the same size as the equipment connection.
- e. Valve Accessibility: All valves shall be located so that they are easily accessible. Valves located above ceilings shall be installed within 24" of the ceiling.

4. Pipe Support:

- a. General: Hangers shall be placed to support piping without strain

on joints or fittings. Maximum spacing between supports shall be as specified below. Actual spacing requirements will depend on structural system. Side beam clamps shall be provided with retaining straps to secure the clamp to the opposite side of the beam. Vertical piping shall be supported with riser clamp at 20' on center (maximum). Support pipe within 12" of all changes in direction. Support individual pipes with pipe hanger. Copper piping systems which protrude through a surface for connection to a fixture stop or other outlet shall be secured with a drop ell, Grinnell No. 9788; nipple through surface shall be threaded brass.

1) Pressure Pipe:

<u>Pipe Size (Inches)</u>	Copper	<u>Maximum Spacing* Between Supports (ft.)</u>	
		Sch. 40 steel	Plastic steel
1/2	6	6	4
3/4	6	8	4
1	6	8	4
1-1/4	6	10	4
1-1/2	6	10	4
2	10	10	4
2-1/2	10	10	4
3	10	10	4
4	10	10	4

\*Based on straight lengths of pipe with couplings only. Provide additional supports for equipment, valves or other fittings. Plastic piping shall be supported per the manufacturer's recommendations. Seismic requirements may reduce maximum spacing.

2) Gravity Drain Pipe: Piping shall be supported at each length of pipe or fitting, but in no case at greater spacing than indicated above for pressure pipe.

- b. Hot and Cold Water Piping: All hot and cold water piping shall have isolating shield; no portion of this piping shall touch the structure without an isolating shield except at anchor points for fixture rough-in.
- c. Trapeze: Trapeze hangers of construction channel and pipe clamps may be used. Submit design to Engineer for review.

5. Miscellaneous:

- a. Escutcheons: Provide chrome plated metal escutcheons where piping penetrates walls, ceilings, or floors in finished areas.
  - b. Pipe Sleeves: All piping passing through concrete shall be provided with pipe sleeves. Allow 1" annular clearance between sleeve and pipe for piping 3" and smaller, otherwise 2" annular clearance. Piping through walls below grade shall be sealed with Link-Seal.
  - c. Pipes Passing through Fire Rated Surfaces: Pipes passing through fire rated walls, floors, ceilings, partitions, etc. shall have the annular space surrounding the pipe or pipe insulation sealed with fire rated materials in accordance with the requirements of the fire authority having jurisdiction.
  - d. Dielectric Couplings: Dielectric couplings shall be installed wherever piping of dissimilar metals are joined, except that bronze valves may be installed in ferrous piping without dielectric couplings.
  - e. Exposed Pipe at Fixtures: Piping extending from finished surfaces into a finished room shall be chrome plated brass.
- B. Sanitary Sewer Piping:
1. General: Where inverts are not indicated, sanitary sewer piping shall be installed at 1/4" per foot pitch. Piping 4" and larger may be installed at 1/8" per foot pitch where structural or other limitations prevent installation at a greater pitch. Bell and spigot piping shall be installed with barrel on sand bed; excavate hole for bell.
  2. Cleanouts: Install cleanouts at ends of lines, at changes of direction greater than 45 degrees, and at not greater than 100 foot intervals. Locate interior cleanouts in accessible locations and bring flush to finished surface.
  3. Vents: Vents shall terminate not less than 6" above the roof nor less than 24" from any vertical surface nor within 10' of any outside air intake. Install horizontal vent lines at 1/4" per foot pitch. Offset vents 2' minimum from gutters, parapets, ridges and roof flashing.
- C. Water Piping: Connections to branches and risers shall be made from top of main. Supply header in fixture battery shall be full size to last fixture, reducing in size only on individual connections to each fixture in battery. Minimum pipe size shall be 3/4", unless otherwise noted. Exposed fixture stops and flush valves shall be installed with brass nipples for copper piping and galvanized nipples for galvanized piping. Nipples are to extend from outside of wall to fitting at header or drop behind finish wall surfaces. Pipe nipples shall be same size as stop or flush valve. Provide shut off for each building and each connection to equipment. Shock absorbers shall be installed in a vertical position per manufacturer's instructions and per PDI-WH 201 where flush valves, metering faucets or other fast acting valves are

connected to the domestic piping system.

- D. Drain Piping (Including Condensate): Install with constant pitch to receptacle, 1/4" per foot where possible, otherwise 1/8" per foot minimum. Provide TEE with clean-out plug at all changes of direction. Provide trap at each air handling unit to prevent air leakage. Only equipment mounted on vibration isolators shall be connected with flexible connection. Piping not concealed in wall structure, above ceilings or below floors shall be chrome plated brass.
- E. PVC Piping: Shall be cut square and assembled prior to solvent weld. Apply primer per manufacturer's recommendations. Coat male joint fully with solvent, make joint before solvent dries and wipe exterior clean.

### 3.2 PIPING INSULATION INSTALLATION:

- A. Domestic Hot Water:
  - 1. General: All domestic hot water piping, fittings and accessories shall be insulated.
  - 2. Pipe: Apply pre-molded fiberglass sections to pipe using integral pressure sealing lap adhesive in accordance with manufacturer's recommendations. Stagger longitudinal joints. Seal butt joints with factory supplied pressure sealing tape.
  - 3. Fittings and Valves:
    - a. Wrap all fittings and valves with pre-cut fiberglass blanket to thickness matching adjoining insulation. Cover blanket with PVC jacket in accordance with manufacturer's recommendations. Solvent weld. Seal all joints with factory supplied pressure sealing vapor barrier tape with 1-1/2" (min.) overlap on both sides of joint. Insulate valves to stem. Do not insulate unions, flanges or valves unless water temperature exceeds 140°F or the piping is exposed to weather.
    - b. For miscellaneous fittings and accessories for which PVC jackets are not available or where proximity of fittings precludes a neat-appearing installation, the Contractor may cover the fiberglass blanket with stretchable glass fabric, one coat of lagging adhesive and a final coat of vapor barrier coating. All exposed ends of insulation shall be adequately sealed.
  - 4. Additional Finish for Exposed Piping and Equipment: All piping and equipment exposed to view but protected from the weather shall be given an additional finish of PVC jackets.
- B. Cold Water Piping-Freeze Protection: All cold water piping exposed to weather

shall be wrapped with insulating tape, 50% overlap. Cover valves to stem. Apply at least two coats of protective finish.

- C. Piping Insulation Under Disabled Accessible Lavatories and Sinks: Hot and cold water piping, hot and cold water stop and drain piping under disabled accessible lavatories and sinks shall be insulated with 3/16" thick molded closed cell vinyl to prevent accidental injury due to contact or temperature extremes. Installation shall be in accordance with manufacturer's instructions. There shall be no sharp or abrasive surfaces under disabled accessible lavatories and sinks.

### 3.3 FIXTURE INSTALLATION

- A. Fixture Height: Shall be as indicated on Architectural drawings.
- B. Floor Drains or Floor Sinks: Shall be placed parallel to room surfaces, set level, flush with floor, and adjusted to proper height to drain. Cover openings during construction to keep all foreign matter out of drain line.
- C. Wall Hung Fixtures: Shall be provided with proper backing and hanger plates secured to wall. Lavatories shall be supported with concealed arm supports. Fixtures mounted on carriers shall bear against stop nuts, clear of wall surface. Caulk fixtures against walls with white G.E. "Sanitary 1700" silicone sealant. Caulking shall be smooth and flush with fixture surface (not concave).
- D. Floor Mounted Fixtures: Shall be provided with proper support plates. Grout at the floor with waterproof ceramic tile grout.
- E. Other Connections: Rough-in and connection for trim or fixtures supplied by others shall be included in this specification section.

### 3.4 EQUIPMENT INSTALLATION

- A. General: It shall be the responsibility of the equipment installer to insure that no work done under other specification sections shall in any way block, or otherwise hinder the equipment. All equipment shall be securely anchored in place.
- B. Connections to Equipment: Where size changes are required for connections to equipment, they shall be made immediately adjacent to the equipment and, if possible, inside the equipment cabinet.

### 3.5 TESTS AND ADJUSTMENTS

- A. General: Unless otherwise directed, tests shall be witnessed by a representative of the Engineer. Work to be concealed shall not be enclosed until prescribed tests are made. Should any work be enclosed before such tests, the Contractor shall, at his



expense, uncover, test and repair all work to original conditions. Leaks and defects shown by tests shall be repaired and entire work retested. Tests may be made in sections, however, all connections between sections previously tested and new section shall be included in the new test.

B. Gravity Systems:

1. Sanitary Sewer: All ends of the sanitary sewer system shall be capped and lines filled with water to the top of the highest vent, 10' above grade minimum. This test shall be made before any fixtures are installed. Test shall be maintained until all joints have been inspected, but no less than 2 hours.
2. Drains (Including Condensate): Similar to Sanitary Sewer.

C. Pressure Systems:

1. General: There shall be no drop in pressure during test except that due to ambient temperature changes. All components of system not rated for test pressure shall be isolated from system before test is made.
2. Domestic Hot and Cold Water Piping: Maintain 100 psig water pressure for 4 hours.

### 3.6 DISINFECTION

- A. Disinfect all domestic water piping systems in accordance with AWWA Standard C651, "AWWA Standard for Disinfecting Water Mains", and in accordance with administrative authority. Disinfection process shall be performed in cooperation with health department having jurisdiction and witnessed by a representative of the Engineer. During procedure signs shall be posted at each water outlet stating, "Chlorination - Do Not Drink". After disinfection, water samples shall be collected for bacteriological analysis. Certificate of Bacteriological Purity shall be obtained and delivered to the Owner through the Engineer.

END OF SECTION

**SECTION 22 40 10**  
**PLUMBING SPECIALTIES (SITE WORK)**

**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- A. The work required under this section consists of related items necessary and required to complete the work. The Contractor shall provide all items, and operations, including all labor, materials, equipment, and incidentals necessary for completion of work.
- B. Section Includes
  - 1. Backflow Preventers

**1.2 RELATED WORK**

- A. Section 40 05 00 - Pipe and Fittings.
- B. Section 40 20 90 – PVC and CPVC Process and Chemical Piping

**1.3 REFERENCES**

- A. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers.
- B. ANSI/ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
- C. ANSI A112.21.1 - Floor Drains.
- D. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.

**1.4 SUBMITTALS**

- A. Submittals shall be in accordance with the General Conditions and Section 01 33 00 – Submittal Procedures
- B. The information shall include but shall not be limited to the following:
  - 1. Complete assembly, foundations, and installation drawings, together with detailed specifications and data covering materials used and accessories forming part of the equipment furnished.
  - 2. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
  - 3. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

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4. Manufacturer's Installation Instructions: Indicate assembly and support requirements.
5. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, trap primers.
6. Operation and Maintenance Data: Indicate frequency of treatment required for interceptors. Include spare parts lists, exploded assembly views.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept specialties on site in original factory packaging. Inspect for damage.

## PART 2 PRODUCTS

### 2.1 BACKFLOW PREVENTERS

- A. Manufacturers
  1. Febco
  2. Watts
  3. Wilkins
- B. Reduced Pressure (RPP) Backflow Preventers: ANSI/ASSE 1013; bronze body with bronze and plastic internal parts and stainless steel springs; two independently-operating, spring loaded check valves; diaphragm-type differential pressure relief valve located between check valves; third check valve which opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks,
  1. RPP Backflow preventer shall be Febco Model 825Y, or Engineer-approved equivalent.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

### 3.2 INSTALLATION - GENERAL

- A. Install in accordance with manufacturer's instructions.

### 3.3 *INSTALLATION - BACKFLOW PREVENTERS*

- A. Install backflow and back-siphoning prevention devices to protect the water supply as required by CCR Title 24, Part 5, California Plumbing Code.
- B. Vacuum Breakers:
  - 1. Mount at least 6 inches above the highest point of discharge.
  - 2. Locate after the last valve; there shall be no downstream valves.
- C. Pressure Vacuum Breakers:
  - 1. Mount at least 12 inches above the highest point of discharge.
  - 2. Pressure vacuum breakers may have downstream valves, but must not be subjected to backpressure.
- D. Reduced-Pressure-Principle Backflow Prevention Devices:
  - 1. Mount at least 12 inches above grade.

### 3.4 *FIELD QUALITY CONTROL - TESTING AND INSPECTION*

- A. Testing of backflow protection and anti-siphon devices prior to activation of the water supply line shall be performed by a Certified Tester.
- B. Devices shall conform to the requirements of applicable codes, or the following requirements, whichever are the more stringent.
- C. Atmospheric Vacuum Breaker:
  - 1. Perform visual inspection.
    - a. Verify there are no downstream valves.
    - b. Verify there are no leaks or mineral stains indicating leaks from the vent.
- D. Pressure Vacuum Breaker:
  - 1. Test opening pressure differential of the air inlet valve.
  - 2. Air inlet valve shall open when the pressure in the body is no less than 1.0 psi above the atmospheric pressure; the air opening valve shall be fully open when the water drains from the body.
  - 3. Test check valve for tightness in the direction of flow. The check valve shall be drip-tight in the normal direction of flow when the inlet pressure is 1.0 psi and the outlet pressure is atmospheric.

E. Reduced-Pressure-Principle Devices:

1. Test operation of the pressure differential relief valve.
2. The zone between the two check valves shall be at least 2.0 psi less than the supply pressure.
3. Test Check Valve Number 2 for tightness against reverse flow. Valve shall be tight against reverse flow under all pressure differentials.
4. Determine static pressure drop across Check Valve Number 1. Pressure drop shall be at least 3.0 psi greater than the pressure differential between the line pressure and the pressure in the zone required to open the pressure differential relief valve.

3.5 *ADJUSTING*

- A. Repair or replace items not conforming to specified requirements at no additional cost to Owner.

**END SECTION**

## SECTION 23 05 00

### COMMON WORK RESULTS FOR HVAC

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Transition fittings.
  - 3. Mechanical sleeve seals.
  - 4. Sleeves.
  - 5. Escutcheons.
  - 6. Grout.
  - 7. Equipment installation requirements common to equipment sections.
  - 8. Building flush-out requirements.
  - 9. Painting and finishing.
  - 10. Concrete bases.
  - 11. Supports and anchorages.

##### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.

#### 1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Mechanical sleeve seals.

B. Welding certificates.

#### 1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

## 1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### 2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.



- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
  - 1. CPVC Piping: ASTM F 493.
  - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

## 2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  - 1. Manufacturers:
    - a. Eslon Thermoplastics.
    - b. Approved equivalent.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  - 1. Manufacturers:
    - a. Thompson Plastics, Inc.
    - b. Approved equivalent.
- C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
  - 1. Manufacturers:
    - a. NIBCO INC.
    - b. Approved equivalent.

## 2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Carbon steel or Stainless steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.6 SLEEVES

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. PVC Pipe: ASTM D 1785, Schedule 40.

## 2.7 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated.

## 2.8 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## 2.9 ACCESS DOORS

- A. Size for proper access, adjusting and maintenance:
  - 1. 12 in. x 12 in. minimum for valve, trap primers, shock absorbers, etc.
  - 2. 24 in. x 24 in. for man access to concealed fans, coils, etc., unless indicated otherwise.
- B. Provide as required by work in Division 22, 23, and 25.
- C. Style, color, and finish to match adjacent construction and as approved by Architect.

## PART 3 - EXECUTION

### 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.

- M. Sleeves are not required for core-drilled holes.
- N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. PVC or Steel Pipe Sleeves: For pipes smaller than NPS 6.
      - 1) Seal space outside of sleeve fittings with grout.
  - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.
- O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  - 2. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.

- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

### 3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2-1/2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 3 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.5 ACCESS TO VALVE AND EQUIPMENT

- A. Access shall be possible where valves, expansion joints, fire dampers, motors, filters, control devices, and any other equipment requiring access for servicing, repairs, or maintenance are located in walls, soffits, chases, and/or above ceilings.
- B. Definition of Accessible:
  - 1. Valves and dampers may be operated.
  - 2. Control devices may be adjusted.
  - 3. Fire dampers may be reset.
  - 4. Equipment access panels may be opened.
  - 5. Normal maintenance work such as replacement of filters, lubrication of bearings, etc., may be performed readily within arm's reach of access opening.
  - 6. It shall not be necessary to crawl through furred ceiling space to perform such operations.
- C. Install piping, equipment and accessories to permit easy access for maintenance.
- D. Group concealed valves, expansion joints, controls, dampers and equipment requiring service access, so as to be freely accessible through access doors and to minimize the number of access doors required.

- E. Relocate piping equipment and accessories as required, at no extra cost to afford proper maintenance access.
- F. Coordinate location of access panels with applicable trades installing walls or ceiling.
  - 1. Coordinate panel locations with lights and other architectural features.
  - 2. Submit proposed panel locations to Architect for review.
- G. Arrange for location and marking of removable tiles in splined ceilings where access panels are not installed.

### 3.6 PAINTING

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.7 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  - 1. Construct concrete bases of dimensions indicated, but not less than 6 inches larger in both directions than supported unit.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03.

### 3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

### 3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

### 3.10 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION



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## SECTION 23 05 13

### COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section includes general requirements for single-phase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

##### 1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

#### PART 2 - PRODUCTS

##### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

##### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

Common Motor Req for HVAC Equip  
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- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

## 2.3 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be DC electronic commutation type (ECM) specifically designed for fan applications. Prewired to the specific voltage and phase. Internal motor shall convert AC supplied to the fan to DC power to operate the motor. Motor shall be controllable down to 20% of full speed. Speed shall be controlled by either potentiometer dial mounted on the motor or by a 0-10 VDC signal. Motor shall be a minimum of 85% efficient at all speeds.
- B. Bearings: Permanently lubricated, heavy duty ball bearings suitable for radial and thrust loading.
- C. Motors 1/20 HP and Smaller: Shaded-pole type.
- D. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

## PART 3 - EXECUTION (Not Applicable)

END OF SECTION

## **SECTION 23 05 29**

### **HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

###### **A. Section Includes:**

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fastener systems.
4. Equipment supports.

##### **1.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to SMACNA SEISMIC RESTRAINT MANUAL.
1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
  2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
  3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

##### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.

##### **1.4 QUALITY ASSURANCE**

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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## PART 2 - PRODUCTS

### 2.1 METAL PIPE HANGERS AND SUPPORTS

#### A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

#### B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

#### C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

### 2.2 TRAPEZE PIPE HANGERS

- #### A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

### 2.3 FASTENER SYSTEMS

- #### A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 2.4 EQUIPMENT SUPPORTS

- #### A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.5 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fastener System Installation:
  - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Install lateral bracing with pipe hangers and supports to prevent swaying.

- H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- K. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
    - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
  - 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.



- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
  - 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
  - 3. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
  - 4. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  - 5. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  4. C-Clamps (MSS Type 23): For structural shapes.
  5. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
  2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
- O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

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## SECTION 23 05 53

### IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
1. Equipment labels.
  2. Warning signs and labels.
  3. Pipe labels.

##### 1.2 SUBMITTAL

- A. Product Data: For each type of product indicated.

#### PART 2 - PRODUCTS

##### 2.1 EQUIPMENT LABELS

- A. Metal Labels for Outdoor Equipment:
1. Material and Thickness: Brass, 0.032-inch (0.8-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware. Lettering to be permanently engraved.
  2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
  3. Minimum Letter Size: 1/2 inch (13 mm). Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  4. Fasteners: Stainless-steel rivets or self-tapping screws.
- B. Plastic Labels for Indoor Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
  2. Letter Color: Black.
  3. Background Color: White.
  4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
  5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

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6. Minimum Letter Size: 1/2 inch (13 mm). Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: Red.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

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- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 20 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
- C. Pipe Label Color Schedule:
  - 1. Refrigerant Piping:
    - a. Background Color: Yellow.

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County of Fresno  
Westside Groundwater Project  
CSA 30 & 32 – Well Site Improvements

b. Letter Color: Black.

END OF SECTION 230553

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## SECTION 23 05 93

### TESTING, ADJUSTING, AND BALANCING FOR HVAC

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Balancing Air Systems:
    - a. Constant-air-volume air systems.

##### 1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.
- F. NBC: National Balancing Council

##### 1.3 SUBMITTALS

- A. Certified TAB reports.

##### 1.4 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB, TABB, or NBC with a minimum of 15 years of successful testing, adjusting, and balancing experience.
  - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC NEBB, TABB or NBC.
  - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC NEBB, TABB, or NBC as a TAB technician.
- B. Certify TAB field data reports and perform the following:



1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

## 1.5 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

## 1.6 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.
- C. Coordinate with Div 01 81 00 and Div 23 08 00 for Commissioning requirements.

## PART 2 - PRODUCTS (Not Applicable)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

- E. Examine equipment performance data including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- K. Examine operating safety interlocks and controls on HVAC equipment.
- L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
  - 1. Permanent electrical-power wiring is complete.
  - 2. Automatic temperature-control systems are operational.
  - 3. Equipment and duct access doors are securely closed.
  - 4. Balance, smoke, and fire dampers are open.
  - 5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

6. Windows and doors can be closed so indicated conditions for system operations can be met.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE 111 and in this Section.
  1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.

- J. Check for proper sealing of air-handling-unit components.
- K. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

### 3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
  - 2. Measure fan static pressures as follows to determine actual static pressure:
    - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Report the cleanliness status of filters and the time static pressures are measured.
  - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
  - 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  - 6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  - 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur.

Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
  - 1. Measure airflow of submain and branch ducts.
    - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  - 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
  - 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
  - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
  - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### 3.6 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  - 1. Manufacturer's name, model number, and serial number.
  - 2. Motor horsepower rating.
  - 3. Motor rpm.
  - 4. Efficiency rating.
  - 5. Nameplate and measured voltage, each phase.
  - 6. Nameplate and measured amperage, each phase.
  - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove

proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

### 3.7 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

### 3.8 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each electric heating coil:
  - 1. Nameplate data.
  - 2. Airflow.
  - 3. Entering- and leaving-air temperature at full load.
  - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
  - 5. Calculated kilowatt at full load.
  - 6. Fuse or circuit-breaker rating for overload protection.
- B. Measure, adjust, and record the following data for each refrigerant coil:
  - 1. Dry-bulb temperature of entering and leaving air.
  - 2. Wet-bulb temperature of entering and leaving air.
  - 3. Airflow.
  - 4. Air pressure drop.
  - 5. Refrigerant suction pressure and temperature.

### 3.9 TOLERANCES

- A. Set HVAC system's air flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
  - 2. Air Outlets and Inlets: Plus or minus 10 percent.
  - 3. Outside Air Rates: Plus or minus 10 percent.

### 3.10 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing.

Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

### 3.11 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
  2. Manufacturers' test data.
  3. Field test reports prepared by system and equipment installers.
  4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
  2. Name and address of the TAB contractor.
  3. Project name.
  4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.

- c. Cooling coil, wet- and dry-bulb conditions.
  - d. Face and bypass damper settings at coils.
  - e. Fan drive settings including settings and percentage of maximum pitch diameter.
  - f. Inlet vane settings for variable-air-volume systems.
  - g. Settings for supply-air, static-pressure controller.
  - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Duct, outlet, and inlet sizes.
  3. Terminal units.
  4. Balancing stations.
  5. Position of balancing devices.

END OF SECTION



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## SECTION 23 07 00

### HVAC INSULATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Insulation Materials:
  - a. Flexible elastomeric.
  - b. Mineral fiber.
2. Adhesives.
3. Mastics.
4. Sealants.
5. Factory-applied jackets.
6. Field-applied jackets.
7. Tapes.
8. Securements.
9. Corner angles.

###### B. Related Sections:

1. Division 22 Section "Plumbing Insulation."
2. Division 23 Section "Metal Ducts" for duct liners.

##### 1.2 SUBMITTALS

- ###### A. Product Data:
- For each type of product indicated.

##### 1.3 QUALITY ASSURANCE

- ###### A. Fire-Test-Response Characteristics:
- Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Duct Wrap.
    - d. Owens Corning; All-Service Duct Wrap.

### 2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; FlameChek.
    - b. Johns Manville; Firetemp Wrap.

- c. Thermal Ceramics; FireMaster Duct Wrap.
- d. 3M; Fire Barrier Wrap Products.

## 2.3 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Insulco, Division of MFS, Inc.; SmoothKote.
    - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
    - c. Rock Wool Manufacturing Company; Delta One Shot.

## 2.4 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA Inc.; AeroSeal.
    - b. Armacell LCC; 520 Adhesive.
    - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    - d. RBX Corporation; Rubatex Contact Adhesive.
  - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
  - 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Products, Division of ITW; CP-82.
  - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
  - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
  - d. Marathon Industries, Inc.; 225.
  - e. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Chemical Company (The); 739, Dow Silicone.
    - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Speedline Corporation; Speedline Vinyl Adhesive.
  2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.5 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 500 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-35.
    - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
    - c. ITW TACC, Division of Illinois Tool Works; CB-50.
    - d. Marathon Industries, Inc.; 590.
    - e. Mon-Eco Industries, Inc.; 55-40.
    - f. Vimasco Corporation; 749.
  2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
  4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
  5. Color: White.

- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-10.
    - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
    - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
    - d. Marathon Industries, Inc.; 550.
    - e. Mon-Eco Industries, Inc.; 55-50.
    - f. Vimasco Corporation; WC-1/WC-5.
  2. Water-Vapor Permeance: ASTM F 1249, 3 perms (2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 200 deg F (Minus 29 to plus 93 deg C).
  4. Solids Content: 63 percent by volume and 73 percent by weight.
  5. Color: White.

## 2.6 SEALANTS

### A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Products, Division of ITW; CP-76.
  - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Pittsburgh Corning Corporation; Pittseal 444.

### B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Products, Division of ITW; CP-76-8.
  - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto PVC Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

- a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
5. Factory-fabricated tank heads and tank side panels.
- C. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; Metal Jacketing Systems.
    - b. PABCO Metals Corporation; Surefit.
    - c. RPR Products, Inc.; Insul-Mate.
  2. Sheet and roll stock ready for shop or field sizing.
  3. Finish and thickness are indicated in field-applied jacket schedules.
  4. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
  5. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
  6. Factory-Fabricated Fitting Covers:
    - a. Same material, finish, and thickness as jacket.
    - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - c. Tee covers.
    - d. Flange and union covers.
    - e. End caps.
    - f. Beveled collars.
    - g. Valve covers.
    - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

## 2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
    - b. Compac Corp.; 104 and 105.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: 3 inches (75 mm).
  3. Thickness: 11.5 mils (0.29 mm).
  4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.



5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - b. Compac Corp.; 110 and 111.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
    - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
  2. Width: 3 inches (75 mm).
  3. Thickness: 6.5 mils (0.16 mm).
  4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    - b. Compac Corp.; 130.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    - d. Venture Tape; 1506 CW NS.
  2. Width: 2 inches (50 mm).
  3. Thickness: 6 mils (0.15 mm).
  4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - b. Compac Corp.; 120.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    - d. Venture Tape; 3520 CW.
  2. Width: 2 inches (50 mm).
  3. Thickness: 3.7 mils (0.093 mm).
  4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
  5. Elongation: 5 percent.

6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

## 2.10 SECUREMENTS

### A. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
    - 2) GEMCO; Perforated Base.
    - 3) Midwest Fasteners, Inc.; Spindle.
  - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
  - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; RC-150.
    - 2) GEMCO; R-150.
    - 3) Midwest Fasteners, Inc.; WA-150.
    - 4) Nelson Stud Welding; Speed Clips.
  - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
3. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
  - a. Products: Subject to compliance with requirements, provide one of the following:

- 1) GEMCO.
  - 2) Midwest Fasteners, Inc.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- C. Wire: 0.062-inch (1.6-mm) soft-annealed, galvanized steel.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. C & F Wire.
    - b. Childers Products.
    - c. PABCO Metals Corporation.
    - d. RPR Products, Inc.

## 2.11 CORNER ANGLES

- A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.

- a. For below ambient services, apply vapor-barrier mastic over staples.
- 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
- 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Manholes.
  - 5. Handholes.
  - 6. Cleanouts.

### 3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).
1. Comply with requirements in Division 07 Section "Penetration Firestopping" and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
  2. Pipe: Install insulation continuously through floor penetrations.
  3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

### 3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
  2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.5 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.



### 3.6 MINERAL-FIBER INSULATION INSTALLATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

#### B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

#### C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

#### D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

#### E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
  - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
  - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Impale insulation over pins and attach speed washers.
  - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
  - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).
5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

### 3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

### 3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

### 3.9 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Do not field paint aluminum or stainless-steel jackets.

### 3.10 DUCT INSULATION SCHEDULE, GENERAL

#### A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, concealed return located in nonconditioned space.
3. Outdoor, concealed supply and return.
4. Outdoor, exposed supply and return.

#### B. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

### 3.11 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket, 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density (R-8 minimum).
- B. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket, 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density (R-8 minimum).

### 3.12 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  1. Drainage piping located in crawl spaces.
  2. Underground piping.
  3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping: Flexible elastomeric, 1 inch (25 mm) thick.

### 3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping: Insulation shall be one of the following:

1. Flexible Elastomeric: 1 inches (25 mm) thick.

### 3.15 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Exposed:
  1. None.
- D. Piping, Exposed:
  1. PVC: 20 mils (0.5 mm) thick.

### 3.16 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
  1. None.
- D. Piping, Exposed:
  1. Aluminum, corrugated: 0.024 inches thick.

END OF SECTION

## **SECTION 23 23 00**

### **REFRIGERANT PIPING**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. This Section includes refrigerant piping used for air-conditioning applications.

##### **1.2 PERFORMANCE REQUIREMENTS**

- A. Line Test Pressure for Refrigerant R-410A:
  - 1. Suction Lines for Air-Conditioning Applications: 185 psig (1276 kPa).
  - 2. Suction Lines for Heat-Pump Applications: 325 psig (2241 kPa).

##### **1.3 SUBMITTALS**

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.
  - 1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

##### **1.4 QUALITY ASSURANCE**

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

##### **1.5 PRODUCT STORAGE AND HANDLING**

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

## PART 2 - PRODUCTS

### 2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
  - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
  - 2. End Connections: Socket ends.
  - 3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
  - 4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
  - 5. Maximum Operating Temperature: 250 deg F (121 deg C).

### 2.2 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
  - 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
  - 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
  - 3. Operator: Rising stem and hand wheel.
  - 4. Seat: Nylon.
  - 5. End Connections: Socket, union, or flanged.
  - 6. Working Pressure Rating: 500 psig (3450 kPa).
  - 7. Maximum Operating Temperature: 275 deg F (135 deg C).
- B. Service Valves:
  - 1. Body: Forged brass with brass cap including key end to remove core.
  - 2. Core: Removable ball-type check valve with stainless-steel spring.
  - 3. Seat: Polytetrafluoroethylene.
  - 4. End Connections: Copper spring.
  - 5. Working Pressure Rating: 500 psig (3450 kPa).
- C. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
  2. Piston, Closing Spring, and Seat Insert: Stainless steel.
  3. Seat Disc: Polytetrafluoroethylene.
  4. End Connections: Threaded.
  5. Working Pressure Rating: 400 psig (2760 kPa).
  6. Maximum Operating Temperature: 240 deg F (116 deg C).
- D. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
  2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  3. Packing and Gaskets: Non-asbestos.
  4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
  5. Suction Temperature: 40 deg F (4.4 deg C).
  6. Superheat: Nonadjustable.
  7. Reverse-flow option (for heat-pump applications).
  8. End Connections: Socket, flare, or threaded union.
  9. Working Pressure Rating: 450 psig (3100 kPa).
- E. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
  2. Screen: 100-mesh stainless steel.
  3. End Connections: Socket or flare.
  4. Working Pressure Rating: 500 psig (3450 kPa).
  5. Maximum Operating Temperature: 275 deg F (135 deg C).
- F. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
  2. Drain Plug: Brass hex plug.
  3. Screen: 100-mesh monel.
  4. End Connections: Socket or flare.
  5. Working Pressure Rating: 500 psig (3450 kPa).
  6. Maximum Operating Temperature: 275 deg F (135 deg C).
- G. Moisture/Liquid Indicators:
1. Body: Forged brass.
  2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
  3. Indicator: Color coded to show moisture content in ppm.
  4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
  5. End Connections: Socket or flare.
  6. Working Pressure Rating: 500 psig (3450 kPa).
  7. Maximum Operating Temperature: 240 deg F (116 deg C).
- H. Replaceable-Core Filter Dryers: Comply with ARI 730.



1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig (14 kPa).
8. Working Pressure Rating: 500 psig (3450 kPa).
9. Maximum Operating Temperature: 240 deg F (116 deg C).

## 2.3 REFRIGERANTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Atofina Chemicals, Inc.
  2. DuPont Company; Fluorochemicals Div.
  3. Honeywell, Inc.; Genetron Refrigerants.
  4. INEOS Fluor Americas LLC.
- B. ASHRAE 34, R-410A: Difluoromethane and Pentafluoroethane.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Hot-Gas, Liquid Lines, and Suction Lines for Heat-Pump Applications:
1. NPS 5/8 and Smaller: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
  2. NPS 3/4 to NPS 1 and Smaller: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
  3. NPS 1-1/4 and Smaller: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with 95-5 tin antimony soldered joints.
  4. NPS 1-1/2 to NPS 2: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.
- B. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

### 3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless valves in suction and discharge lines of compressor.

- B. Install service valves for gage taps at strainers if they are not an integral part of strainers.
- C. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- D. Install a full-sized, three-valve bypass around filter dryers.
- E. Install thermostatic expansion valves as close as possible to distributors on evaporators.
  - 1. Install valve so diaphragm case is warmer than bulb.
  - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
  - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- F. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- G. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- H. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
  - 1. Solenoid valves.
  - 2. Thermostatic expansion valves.
  - 3. Compressor.
- I. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- J. Install flexible connectors at compressors.

### 3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install piping per equipment manufacturers requirements and guidelines for slope, distance, changes in direction, changes in elevation and branching.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope downward to compressor.
  - 3. Install traps and double risers to entrain oil in vertical runs.
  - 4. Liquid lines may be installed level.
- O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- P. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- Q. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

- S. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- T. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.
- U. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

### 3.4 PIPE JOINT CONSTRUCTION

- A. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
  - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
  - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

### 3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
  - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
  - 4. Spring hangers to support vertical runs.
  - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
  - 1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
  - 2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
  - 3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).

4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
6. NPS 2 (DN 50): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
7. All sizes, provide supports within 12 inches of all changes in direction.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  1. Comply with ASME B31.5, Chapter VI.
  2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
  3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
    - a. Fill system with nitrogen to the required test pressure.
    - b. System shall maintain test pressure at the manifold gage throughout duration of test.
    - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

### 3.7 SYSTEM CHARGING

- A. Charge system using the following procedures and per equipment manufacturers instructions:
  1. Install core in filter dryers after leak test but before evacuation.
  2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
  3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
  4. Charge system with a new filter-dryer core in charging line.

### 3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
  - 1. Verify that compressor oil level is correct.
  - 2. Open compressor suction and discharge valves.
  - 3. Open refrigerant valves except bypass valves that are used for other purposes.
  - 4. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

## **SECTION 23 31 13**

### **METAL DUCTS**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

###### **A. Section Includes:**

1. Round ducts and fittings.
2. Sheet metal materials.
3. Sealants and gaskets.
4. Hangers and supports.
5. Seismic-restraint devices.

###### **B. Related Sections:**

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

##### **1.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

##### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.

## PART 2 - PRODUCTS

### 2.1 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. McGill AirFlow LLC.
    - b. SEMCO Incorporated.
    - c. Sheet Metal Connectors, Inc.
    - d. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Fabricate round ducts larger Than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 2.2 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.



- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G60 (Z180).
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
  - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

### 2.3 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
  - 1. Application Method: Brush on.
  - 2. Solids Content: Minimum 65 percent.
  - 3. Shore A Hardness: Minimum 20.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. VOC: Maximum 75 g/L (less water).
  - 7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
  - 8. Service: Indoor or outdoor.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
  - 1. General: Single-component, acid-curing, silicone, elastomeric.
  - 2. Type: S.
  - 3. Grade: NS.
  - 4. Class: 25.
  - 5. Use: O.
  - 6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.4 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
  1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

## 2.5 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Cooper B-Line, Inc.; a division of Cooper Industries.
  2. Kinetics Noise Control.
  3. Mason Industries.
  4. TOLCO; a brand of NIBCO INC.
  5. Unistrut Corporation; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- D. Restraint Cables: ASTM A 603, galvanized or ASTM A 492, stainless-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors installed and/or stored on site from moisture, construction debris and dust, and other foreign materials.
  - 1. Cover and seal open ends of ducts with plastic wrap and duct tape.
  - 2. Turn off ventilation system and protect duct interiors from dust infiltration during dust producing activities (e.g. demolition, drywall installation, finishing).
  - 3. At the end of each workday, cover and seal open ends or openings of installed ducts with plastic wrap and duct tape.

### 3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### 3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE 7-10 Chapter 13, 26, and 30 and 2013 CBC Section 1616A.1.23-26.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:

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1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

### 3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.7 PAINTING

- A. Paint exterior of metal ducts that are visible. Paint materials and application requirements are specified in Division 09 painting Sections.

### 3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
  1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
  2. Test the following systems:
    - a. Supply Ducts with a Pressure Class of 2-inch wg or higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
  3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  4. Test for leaks before applying external insulation.
  5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system

at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

### 3.9 DUCT CLEANING

A. Clean duct system(s) before testing, adjusting, and balancing.

B. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.

2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

C. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.

3. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.

4. Dedicated exhaust and ventilation components and makeup air systems.

### 3.10 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

### 3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.

B. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

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- a. Pressure Class: Negative 2-inch wg (500 Pa).
- b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
- c. SMACNA Leakage Class for Round and Flat Oval: 12.

C. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.

D. Liner:

1. Return- and Exhaust-Fan Plenums: Fibrous glass, Type II, 2 inches (51 mm) thick.

E. Elbow Configuration:

1. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
  - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
    - 2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
    - 3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
    - 4) Radius-to Diameter Ratio: 1.5.
  - b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam.

END OF SECTION



## SECTION 23 81 26

### SPLIT-SYSTEM AIR-CONDITIONERS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

##### 1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

##### 1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

- D. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

## 1.5 COORDINATION

- A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

## 1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters: One set of filters for each unit.
  - 2. Fan Belts: One set of belts for each unit.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Daikin
  - 2. Mitsubishi Electronics America, Inc.; HVAC Division.
  - 3. Carrier

### 2.2 CEILING-MOUNTING, EVAPORATOR-FAN COMPONENTS

- A. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
  - 1. Drain Pan and Drain Connection: Comply with ASHRAE 62.1-2004.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- C. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.

- D. Fan: Direct drive, centrifugal fan and integral condensate pump.
- E. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
- F. Filters: Disposable, with ASHRAE 52.2 MERV rating of 8 or higher.

### 2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

- A. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
  - 1. Refrigerant: R-410A.
- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.
- D. Heat Pump Components: Reversing valve and low-temperature air cut-off thermostat.
- E. Fan: Aluminum-propeller type, directly connected to motor.
- F. Motor: Permanently lubricated, with integral thermal-overload protection.
- G. Low Ambient Kit: Permits operation down to 45 deg F.
- H. Mounting Base: Polyethylene.
- I. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1-2004, "Energy Standard for Buildings except Low-Rise Residential Buildings."

### 2.4 ACCESSORIES

- A. Control equipment and sequence of operation are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."
- B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

1. Minimum Insulation Thickness: 1/2 inch thick.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install ground-mounting, compressor-condenser components on 6-inch-thick, reinforced concrete base; 12 inches larger on each side than unit. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.
- D. Install ground-mounting, compressor-condenser components on polyethylene mounting base.
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

### 3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

## SECTION 26 05 00

### BASIC ELECTRICAL MATERIALS AND METHODS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under Division 26.

###### B. Related work under this section

1. Labor and materials required to furnish and install the electrical systems in a complete and operational fashion.
2. Carpentry, masonry, steel and concrete materials and labor required for construction of proper stands, bases and supports for electrical materials and equipment.
3. Cutting and patching of holes required by installation including flashing and counter-flashing of roof and exterior wall penetrations.
4. Excavating, pumping and backfilling required for installation.
5. Repair of damage to the premises resulting from construction activities under this Section to Owner's satisfaction.
6. Removal of work debris from construction activities to Owner's satisfaction.
7. Testing and cleaning of equipment installed.

###### C. Work not under this section

1. Furnishing of motors, pumps, fans, compressors, water heaters, thermostats and motor starters included under Division 40, or as noted otherwise.
2. Finish painting of exposed metal surfaces included under Division 9, or as otherwise noted.
3. Electrical Contractor shall provide connections to mechanical equipment where voltage exceeds 50 V and all necessary raceways for low voltage controls.

###### D. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.

##### 1.02 REFERENCES

- ###### A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
1. CCR –California Code of Regulations

- a. Title 8 –Industrial Relations; Section 1 –Department of Industrial Relations
  - 1) Chapter 3.2 -California Occupational Safety and Health Regulations (CAL/OSHA)
  - 2) Chapter 4 –Section of Industrial Safety
    - a) Subchapter 4 -Construction Safety Orders (CSO)
    - b) Subchapter 5 -Electrical Safety Orders (ESO)
- b. Title 24 –California Building Standards
  - 1) Part 1 -Building Standards Administrative Code
  - 2) Part 2 -California Building Code (CBC); International Building Code (IBC) with California amendments
  - 3) Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
  - 4) Part 4 -California Mechanical Code (MEC); IAPMO Uniform Mechanical Code (UMC) with California amendments
  - 5) Part 5 -California Plumbing Code; IAPMO Uniform Plumbing Code (UPC) with California amendments
  - 6) Part 6 -California Energy Code
  - 7) Part 7 -California Elevator Safety Construction Code
  - 8) Part 9 -California Fire Code; International Fire Code (IFC) with California amendments
  - 9) Part 12 -California Reference Standards Code
2. CPUC –California Public Utilities Commission
  - a. GO-95; Rules for Overhead Electric Line Construction
  - b. GO-128; Rules for Construction of Underground Electric Supply and Communication Systems
3. IEEE –Institute of Electrical and Electronic Engineers
  - a. C2; National Electrical Safety Code (NESC)
4. NECA –National Electrical Contractors Association
  - a. 1; Standard Practices for Good Workmanship in Electrical Contracting
  - b. 4090; Manual of Labor Units
5. All applicable local municipal codes and ordinances.
6. Applicable rules and regulations of local utility companies.

### 1.03 SUBMITTALS

- A. Product Data
  1. Refer to Division 01.
- B. Closeout Submittal

1. Furnish three complete sets of maintenance and operating instructions bound in a binder and indexed to Owner. Start compiling data upon approval of materials and equipment. Final inspection will not be made until Engineer approves binders. Refer also to Division 1 for additional requirements.
2. Provide one of each tool required for proper equipment operation and maintenance provided under this Division. All tools shall be delivered to the Owner at project completion.
3. Provide two keys to Owner for each lock furnished under Division 26.
4. As-Built Drawings
  - a. Refer to Division 01.

#### 1.04 *SUBSTITUTIONS*

1. Refer to Division 00.

#### 1.05 *CHANGE ORDER PROPOSALS*

- A. Refer to Division 00.
- B. All change order proposals and requests, both additive and deductive, shall be accompanied by a detailed materials and labor breakdown for each specific task and/or item.

#### 1.06 *QUALITY ASSURANCE*

- A. References to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to bid submittal. Such codes or standards shall be considered a part of this Specification as though fully repeated herein.
- B. Work and materials shall be in full accordance with the latest rules and regulations of applicable state or local laws or regulations and standards of following:
  1. National Fire Protection Association (NFPA)
  2. California Electrical Code (CEC)
  3. California Occupational Safety Health Act (Cal-OSHA)
  4. California State Fire Marshall (CSFM)
  5. California Code of Regulations (CCR)
  6. Electrical Safety Orders, CAC Title 8 (ESO)
  7. California Public Utilities Commissions, General Order 95 (GO-95)
  8. Applicable rules and regulations of local utility companies.
  9. NECA 1-2006, Standard Practices for Good Workmanship in Electrical Contracting

- C. All electrical equipment and material furnished under Division 26 shall conform to all CEC requirements and bear the Underwriters' Laboratories (UL) label where applicable.
- D. Nothing in the Construction Documents shall be construed to permit work not conforming to these Codes. Whenever the indicated material, workmanship, arrangement or construction is of high quality or capacity than that required by the above rules and regulations, the Construction Documents shall take precedence. Should there be any direct conflict between the rules and regulations and Construction Documents, the rules shall govern.
- E. All electrical equipment and material furnished under this Division shall conform to NEMA and ASTM standards, CEC and bear the Underwriters' Laboratories (UL) label where such label is applicable.
- F. All electrical work shall conform to manufacturer's written instruction, and the NECA Standard Practices for Good Workmanship in Electrical Contracting and all published recommended practices at the time of project. The Contractor shall use the requirements within the Specifications whenever they exceed NECA guidelines.
- G. Follow manufacturer's direction where these direction cover points not included with the Construction Documents.

#### *1.07 DELIVERY, STORAGE AND HANDLING*

- A. Packing, shipping, handling and unloading
  - 1. Damage to the equipment delivered to the site or in transit to the job shall be the responsibility of the Electrical Contractor.
  - 2. Equipment and material delivery of shall be scheduled as required for timely, expeditious progress of work.
- B. Storage and protection of job equipment is the responsibility Contractor.
- C. Comply with Division 01 requirements with regards to waste management and disposal.

#### *1.08 PROJECT CONDITIONS*

- A. Discrepancies
  - 1. In the event of discrepancies with the Contract Documents, Engineer shall be notified with sufficient time as stated within Division 01 to allow the issuing of an addendum prior to the bid opening.
  - 2. If, in the event that time does not permit notification of clarification of discrepancies prior to the bid opening, the following shall apply:
    - a. The drawings govern in matters of quantity and specifications govern in matters of quality.
    - b. In the event of conflict within the drawings and specifications involving quantities or quality, the greater quantity or higher quality shall apply. Such discrepancies shall be noted and clarified within the contractor's bid. No additional allowances will be made because of errors, ambiguities or



omissions which reasonably should have been discovered during the bid preparation.

- B. Verify all power and communication utilities' requirements prior to commencement of any utility work. Make proper adjustments to the construction to satisfy the serving utility.
- C. Information shown relative to services is based upon available records and data, but shall be regarded as approximate only. Make minor deviations found necessary to conform to actual locations and conditions without extra cost. Verify locations and elevations of utilities prior to commencement of excavation for new underground installation.
- D. Exercise extreme care in excavating near existing utilities to avoid any damage thereto; be responsible for any damage caused by such operations. Contact all utility companies to obtain exact locations prior to commencement of construction.
- E. The electrical plans indicate the general layout and arrangement; the field conditions shall determine exact locations. Field verify all conditions and modify as required to satisfy design intent. Maintain all required working clearances.
- F. Fees, permits and utility services
  - 1. Obtain and pay for all permits and service charges required for the installation of this work. Arrange for required inspections and secure approvals from authorities having jurisdiction. Arrange for all utility connections and pay charges incurred including excess service charges if any.
  - 2. Extra charges imposed by the electrical and communication utility companies shall be included in the bid, if available. Unless otherwise stated, these charges will be assumed to include in the bid.
- G. Provide and maintain temporary construction power. The General Contractor will pay for electric energy charges. Should the Electrical Contractor be the prime contractor, the Electrical Contractor shall pay for energy charges unless negotiated with Owner.

#### **1.09 SEQUENCING**

- A. Coordinate work within phasing plans as provided by the Owner.

#### **1.10 WARRANTY**

- 1. Refer to Section 00 65 36.

### **PART 2 - PRODUCTS**

#### **2.01 MATERIALS**

- A. Materials mentioned herein or on Drawings require that the items be provided and of quality noted or an approved equal. All materials shall be new, full weight, standard in all respects and in first-class condition. Insofar as possible, all materials used

shall be of the same brand or manufacturer throughout for each class of material or equipment.

- B. Trade names or catalog numbers stated herein indicates grade or quality of material desired. Materials, where applicable, shall be UL labeled and in accordance with NEMA standards.
- C. Dimensions, sizes and capacities shown are a minimum. Do not make changes without written permission of Engineer.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine Construction Documents and Site; be familiar with types of construction where electrical installation is involved. Note carefully other sections of Specifications with their individual cross-references, standard details, etc.
- B. Any electrical work or materials shown either in Construction Documents, but not mentioned herein, or vice versa, shall be executed the same as if mentioned herein, in a workmanlike manner in accordance with all published NECA Standards of Installation.
- C. Coordinate work with other crafts to avoid conflicts, and check all outlet locations with drawings and specifications. Make minor adjustments without additional cost to Owner.
- D. Engineer will make clarifications and rulings concerning any obvious discrepancies or omissions in work prior and after bidding. Perform all work involved in correcting obvious errors or omissions after award of contract as directed by Engineer at Contractor's expense.
- E. Examine site dimensions and locations against Drawings and become informed of all conditions under which work is to be done before submitting proposals. No allowance will be made for extra expense due to error.
- F. Layouts of equipment, accessories and wiring systems are diagrammatic (not pictorial), but shall be followed as closely as possible. Construction Documents are for assistance and guidance, and exact locations, distance, levels, etc., will be governed by construction; accept same with this under standing.
- G. Horsepower of motors or wattage of equipment indicated in Construction Documents is estimated horsepower or wattage requirement of equipment furnished under other sections of Specifications. Size all feeders (conduit and wiring), motor starters, overload protection and circuit breakers to suit horsepower of motors or wattage of equipment actually furnished under various sections of specifications. However, in no case shall feeders and branch circuits (conduit and wiring) and circuit breakers be of smaller capacities or sizes than those indicated on Drawings or specified, unless approved in writing by Engineer.

### **3.02 PREPARATION**

- A. Seal all exterior wall penetrations in an approved watertight manner and to the satisfaction of Engineer and Owner.
- B. Channels, joiners, hangers, caps, nuts and bolts and associated parts shall be plated electrolytically with zinc followed immediately thereafter by treating freshly deposited zinc surfaces with chromic acid to obtain a surface which will not form a white deposit on surface for an average of 120 hours when subjected to a standard salt spray cabinet test, or shall be hot dipped galvanized

### 3.03 *INSTALLATION*

- A. Equipment identification
  - 1. Properly identify panelboards, remote control switches, push buttons, terminal boxes, etc. with a descriptive nameplate. Make nameplate with 3/32" laminated plastic with black background and white letters. Machine engraved letters 1/8" high for equipment in device box(es) and 1/4" high for panelboards, terminal cabinets or larger items. Punched strip type nameplates and cardholders in any form are not acceptable. Fasten nameplates with oval head machine screws, tapped into front cover/panel.
- B. Working spaces
  - 1. Provide adequate working space around electrical equipment in compliance with Article 4 of Electrical Safety Orders and CEC 110.26. In general provide 78" of headroom and 30" wide minimum clear workspace in front of panelboards and controls. In addition to the above, provide the following minimum working clearances:
    - a. 0V – 150V (line-to-ground) provide 36" minimum clear distance.
    - b. 151V – 600V (line-to-ground) provide 42" minimum clear distance.
- C. Equipment supports
  - 1. Anchor all electrical equipment to structure. Support systems shall be adequate to withstand seismic forces per CBC.
- D. Excavating and backfilling
  - 1. Excavate and backfill as required for installation of Work. Restore all surfaces, roadways, walks, curbs, walls existing underground installations, etc., cut by installations to original condition in an acceptable manner. Maintain all warning signs, barricades, flares and lanterns as required by ESO and local ordinances.
  - 2. Dig trenches straight and true to line and grade, with bottom clear of any rock points. Support conduit for entire length on undisturbed original earth. Minimum conduit depth of pipe crown shall be 24" below finished or natural grade, unless otherwise noted.
- E. Forming, cutting and patching
  - 1. In new construction, General Contractor shall provide any special forming, recesses, chased, etc., and provide wood blocking, backing and grounds as necessary for the proper installation of electrical work. Be responsible for notifying General Contractor that such provision is necessary; layout work and check to see that it suits his requirements.

- a. Provide metal backing plates, anchor plates and such that are required for anchorage of electrical work under Division 26; securely weld or bolt to metal framing. Wood blocking or backing will not be permitted in combination with metal framing.
  2. Be responsible for proper placement of pipe sleeves, hangers, inserts and supports for this Work.
- F. Concrete work
1. Provide concrete work related solely to electrical work. Concrete work, including forming and reinforcing steel installed for all electrical work, shall comply with all applicable requirements of Division 03, or in accordance with the State of California Standard Specifications issued by the Department of Transportation (CALTRANS).

### 3.04 REPAIR/RESTORATION

- A. Cutting, patching and repairing of existing construction to permit installation of work under Division 26 is the responsibility of Contractor. Repair or replace all damage to existing work in kind to Owner's satisfaction.
- B. Obtain Engineer's approval prior to performing any cutting or patching of concrete, masonry, wood or steel structure within building.

### 3.05 FIELD QUALITY CONTROL

- A. Inspection of work
  1. Working parts shall be readily accessible for inspection, repair and renewal. The right is reserved to make reasonable changes in equipment location shown on Drawings prior to rough in without additional costs to the Owner.
  2. During construction all work will be subject to observation by the Engineer and his representatives. Assist in ascertaining any information that maybe required.
  3. Do not allow or cause any work installed hereunder to be covered up or enclosed before it has been inspected and approved. Should any work be enclosed or covered prior to approval, uncover work, and after it has been inspected and approved, restore work of all others to the condition in which it was found at the time of cutting, all without additional costs to Owner.
- B. Furnish all testing equipment as maybe required.
- C. Test all wiring and connections for continuity and grounds; where such tests indicate faulty insulation or other defects, locate, repair and re-test.
- D. Check rotation of all motors and correct if necessary.

### 3.06 CLEANING

- A. Repair or replace all broken, damaged or otherwise defective parts without additional cost to Owner, and leave entire work in a condition satisfactory to Engineer. At completion, carefully clean and adjust all equipment, fixtures and trim installed as part of this work; leave systems and equipment in satisfactory operating condition.

- B. Clean out and remove from the site all surplus materials and debris resulting from this work; this includes surplus excavated materials.

### 3.07 *DEMONSTRATION*

- A. At project completion, Contractor shall allot a period of not less than 8 hours per well site for instruction of operating and maintenance personnel in the use of all systems installed under this Division. This time is in addition to any instruction time stated in the Specifications of other sections for other equipment (i.e., fire alarm, security, intercom, etc.). All personnel shall be instructed at one time, the Contractor shall make all necessary arrangements with manufacturer's representatives as may be required. Contractor, if any, for the above services shall pay all costs.

### 3.08 *PROTECTION*

- A. In performance of work, protect work of other trades as well as work under this Division from damage.
- B. Protect electrical equipment, stored and installed, from dust, water or other damage.

**END OF SECTION**

## SECTION 26 05 19

### CONDUCTORS AND CABLES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary for the installation of all conductors and cables under this Section related to lighting, power, mechanical, control and signal systems.

###### B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 REFERENCES

###### A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ASTM -American Society for Testing and Materials
  - a. B3; Standard Specification for Soft or Annealed Copper Wire
  - b. B8; Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
  - c. B787/B787M; Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation
  - d. D1000; Standard Test Method for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications
2. CCR –California Code of Regulations, Title 24
  - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
3. UL -Underwriters Laboratories, Inc.
  - a. UL 83; Thermoplastic-Insulated Wire and Cables
  - b. UL 486A 486B; Wire Connectors
  - c. UL 486C; Splicing Wire Connectors
  - d. UL 486D; Standard for Insulated Wire Connector Systems For Underground Use Or In Damp Or Wet Locations

- e. UL 486E; Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
- f. UL 493; Thermoplastic-Insulated Underground Feeders and Branch Circuit Cables
- g. UL 510; Standard for Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
- h. UL 854; Service-Entrance Cables
- 4. NEMA –National Electrical Manufacturer’s Association
  - a. WC 70-1999; Nonshielded Power Cables Rated 2000 Volts or less for the Distribution of Electrical Energy
- 5. IEEE –Institute of Electrical and Electronic Engineers
  - a. 82; Standard Test Procedure for Impulse Voltage Tests on Insulated Conductors

### 1.03 DELIVERY

- A. Wire shall be in original unbroken package. Obtain approval of Inspector or Engineer before installation of wires.

## **PART 2 - PRODUCTS**

### 2.01 BUILDING WIRE

- A. Conductor material
  - 1. Provide annealed copper for all wire, conductor and cable of not less than 98% conductivity.
  - 2. Wire #8 AWG and larger shall be stranded.
  - 3. Wire #10 AWG and smaller shall be solid.
- B. Insulation material
  - 1. All insulated wire, conductor and cable shall be 600 Vac rated.
  - 2. Feeder and branch circuits larger than #6 AWG shall be type THW, XHHW or THHN/THWN.
  - 3. Feeder and branch circuits #6 AWG and smaller shall be type TW, THW, XHHW or THHN/THWN.
  - 4. Control circuits shall be type THW or THHN/THWN.
  - 5. Wires shall bear the UL label, be color-coded and marked with gauge, type and manufacturer’s name on 24” centers.

### 2.02 FLEXIBLE CORDS AND CABLES

- A. Provide flexible cords and cables of size, type and arrangement as indicated on Drawings.

- B. Type S flexible cords and cable shall be manufactured in accordance with CEC Article 400 and composed of two or more conductors and a full sized green insulated grounding conductor with an outer rubber or neoprene jacket.
- C. Flexible cords and cables shall be fitted with wire mesh strain relief grips either as a integral connector component or an independently supported unit.
- D. Suspended flexible cords and cables shall incorporate safety spring(s).

### 2.03 WIRE CONNECTIONS AND TERMINATIONS

- A. Electrical spring wire connectors
  - 1. Provide multi-part construction incorporating a non-restricted, zinc coated square cross-sectional steel spring enclosed in a steel sheet with an outer jacket of plastic and insulating skirt.
  - 2. Self-striping pigtail and tap U-contact connectors are not acceptable.
- B. Compression type terminating lugs
  - 1. Provide tin-plated copper high compression type lugs for installation with hand or hydraulic crimping tools as directed by manufacturer. Notch or single point type crimps are not acceptable.
  - 2. Two hole, long barrel lugs shall be provided for size #4/O AWG and larger wire where terminated to bus bars. Use minimum of three crimps per lug where possible.
- C. Splicing and insulating tape
  - 1. Provide black, UV resistant, self extinguishing, 7 mil thick vinyl general purpose electrical tape per UL 510 and ASTM D1000. 3M Scotch 33 or equal.
- D. Insulating putty
  - 1. Provide pads or rolls of non-corrosive, self-fusing, 125 mil thick rubber putty with PVC backing sheet per UL 510 and ASTM D1000. 3M Scotchfil or equal.
- E. Insulating resin
  - 1. Provide two-part liquid epoxy resin with resin and catalyst in pre-measured, sealed mixing pouch. 3M Scotchcast 4 or equal.
  - 2. Use resin with thermal and dielectric properties equal to the cable's insulating properties.
- F. Terminal strips
  - 1. Provide box type terminal strips in the required quantities plus 25% spare. Install in continuous rows.
  - 2. Use the box type terminal strips with barrier open backs and with ampere ratings as required.
  - 3. Identify all terminal strips and circuits.
- G. Crimp type connectors
  - 1. Provide insulated fork or ring crimp terminals with tinned electrolytic copper-brazed barrel with funnel wire entry and insulation support.



2. Fasten crimp type connectors or terminals using a crimping tool recommended by the manufacturer.
  3. Provide insulated overlap splices with tinned seamless electrolytic copper-brazed barrel with funnel wire entry and insulation support.
  4. Provide insulated butt splices with tinned seamless electrolytic copper-brazed barrel with center stop, funnel wire entry and insulation support.
- H. Cable ties
1. Provide harnessing and point-to-point wire bundling with nylon cable ties. Install using tool supplied by manufacturer as required.
- I. Wire lubricating compound
1. UL listed for the wire insulation and conduit type, and shall not harden or become adhesive.
  2. Shall not be used on wire for isolated type electrical power systems.
- J. Bolt termination hardware
1. Bolts shall be plated, medium carbon steel heat-treated, quenched and tempered equal to ASTM A-325 or SAE Grade 5; or silicon bronze alloy ASTM B-9954 Type B.
  2. Nuts shall be heavy semi-finished hexagon, conforming to ANSI B18.2.2, threads to be unified coarse series (UNC), class 2B steel or silicon bronze alloy.
  3. Flat washers shall be steel or silicon bronze, Type A plain standard wide series, conforming to ANSI B27.2. SAE or narrow series shall be used.
  4. Belleville conical spring washers shall be hardened steel, cadmium plated or silicon bronze.
  5. Each bolt connecting lug(s) to a terminal or bus shall not carry current exceeding the following values:
    - a. 1/4" bolt – 125 A
    - b. 5/16" bolt – 175 A
    - c. 3/8" bolt – 225 A
    - d. 1/2" bolt – 300 A
    - e. 5/8" bolt – 375 A
    - f. 3/4" bolt – 450 A

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Thoroughly examine site conditions for acceptance of wire and cable installation to verify conformance with manufacturer and specification tolerances. Do not commence with work until all conditions are made satisfactory.

### 3.02 *INSTALLATION*

- A. All wire, conductor, and cable with their respective connectors, fittings and supports shall be UL listed for the installed application and ambient conditions.
- B. Feeders and branch circuits in wet locations shall be rated 75°C minimum.
- C. Feeders and branch circuits in dry locations shall be rated 90°C minimum.
- D. Minimum conductor size
  - 1. #12 AWG copper for all power and lighting branch circuits.
  - 2. #14 AWG copper for all line voltage signal and control wiring, unless otherwise indicated.
- E. Remove and replace conductors under the following conditions at no additional costs to the Owner:
  - 1. Installed within wrong specified conduit or raceway.
  - 2. Damaged during installation.
  - 3. Of insufficient length to facilitate proper splice of conductors

### 3.03 *WIRING METHODS*

- A. Install wires and cable in accordance with manufacturer's written instructions, as shown on Drawings and as specified herein.
- B. Install all single conductors within raceway system, unless otherwise indicated.
- C. Parallel circuit conductors and terminations shall be equal in length and identical in all aspects.
- D. Provide adequate length of conductors within electrical enclosures and neatly train to termination points with no excess. Terminate such that there is no bare conductor at the terminal.
- E. Splice cables and wires only in junction boxes, outlet boxes, pull boxes, manholes or handholes.
- F. Group and bundle with tie wrap each neutral with its associated phase conductors where more than one neutral conductor is present within a conduit.
- G. Install cable supports for all vertical feeders in accordance with CEC Article 300. Provide split wedge type fittings, which firmly clamp each individual cable and tighten due to cable weight.
- H. Seal cable where exiting a conduit from an exterior underground raceway with a non-hardening compound (i.e., duct seal or equal).
- I. Provide UL listed factory fabricated, solder-less metal connectors of size, ampacity rating, material, type and class for applications and for services indicated. Use connectors with temperature ratings equal or greater than the conductor or cable being terminated.
- J. Stranded wire shall be terminated using fittings, lugs or devices listed for the application. Under no circumstances shall stranded wire be terminated solely by wrapping it around a screw or bolt.

- K. Flexible cords and cables supplied as part of a pre-manufactured assembly shall be installed according to manufacturer's published instructions.

### 3.04 *WIRING INSTALLATION IN RACEWAYS*

- A. Install wire in raceway after interior of building has been physically protected from weather, and all mechanical work likely to injure conductors has been completed.
- B. Pull all conductors into raceway at the same time.
- C. Use UL listed, non-petroleum base and insulating type pulling compound as needed.
- D. Completely mandrel all underground or concrete encased conduits prior to installation.
- E. Completely and thoroughly swab raceway system prior to installation
- F. Do not use block and tackle, power driven winch or other mechanical means for pulling conductors smaller than #1 AWG.
- G. Wire pulling
  1. Provide installation equipment that will prevent cutting or abrasion of insulation during installation.
  2. Maximum pull tension shall not exceed manufacturer's recommended value during installation for cable being measured with tension dynamometer.
  3. Use rope made of non-metallic material for pulling.
  4. Attach pulling lines by means of either woven basket grips or pulling eyes attached directly to the conductors.
  5. Pull multiple conductors simultaneously within same conduit.

### 3.05 *WIRE SPLICES, JOINTS AND TERMINATIONS*

- A. Join and terminate wire, conductors and cables in accordance with UL 486, CEC and manufacturer's instructions.
- B. Thoroughly clean wires before installing lugs and connectors.
- C. Make splices, taps and terminations to carry full conductor ampacity without perceptible temperature rise, and shall be made mechanically and electrically secure.
- D. Terminate wires in terminal cabinets using terminal strips, unless otherwise indicated.
- E. Insulate spare conductors with electrical tape and leave sufficient length to terminate anywhere within panel or cabinet.
- F. Encapsulate splices in wet locations using specified insulating resin kits.
- G. Make up all splices and taps in accessible junction or outlet boxes with connectors as specified herein. Pigtails and taps shall be the same color as feed conductor with at least 6 inches of tail, all neatly packed within box.

- H. Where conductors are to be connected to metallic surfaces, coated surfaces shall be cleaned to base metal surface before installing connector. Remove lacquer coating of conduits where ground clamps are to be installed.
- I. Branch circuits (#10 AWG and smaller) connectors shall comply with 2.03.A and 2.03.B above.
- J. Branch circuits (#8 AWG and larger)
  - 1. Join or tap conductors using insulated mechanical compression taps with pre-molded, snap-on insulating boots or specified conformable insulating pad and over-wrapped with two half-lapped layers of vinyl insulating tape starting and ending at the middle of joint.
  - 2. Terminate conductors using mechanical compression lugs in accordance with manufacturer's recommendation or as specified elsewhere.
  - 3. Field installed compression connectors for 250 MCM and larger shall have not less than two clamping elements or compression indents per wire.
  - 4. Insulate splices and joints with materials approved for the particular use, location, voltage and temperature.
- K. Termination hardware assemblies
  - 1. Al/Cu lugs connected to aluminum plated or copper bus shall be secured with steel bolt, flat washer (two per bolt), Belleville washer and nut.
  - 2. Copper lugs connected to copper buss shall bus shall be secured using silicon bronze alloy bolt, flat washer (two per bolt), Belleville washer and nut.
  - 3. The crown of Belleville washers shall be under the nut.
  - 4. Bolt assemblies shall be torque to manufacturer's recommendations. Where manufacturer recommendation is not obtainable, the following shall be used:
    - a. 1/4" -20 bolt at 80 inch-pound torque
    - b. 5/16" -18 bolt at 180 inch-pound torque
    - c. 3/8" -20 bolt at 20 inch-pound torque
    - d. 1/2" -20 bolt at 40 inch-pound torque
    - e. 5/8" -20 bolt at 55 inch-pound torque
    - f. 3/4" -20 bolt at 158 inch-pound torque

### 3.06 IDENTIFICATION

- A. Securely tag all branch circuits. Mark conductors with specified vinyl wrap-around markers. Where more than two conductors run through a single outlet, mark each conductor with the corresponding circuit number.
- B. Provide all terminal strips with each individual terminal identified using specified vinyl markers.
- C. In manholes, pullboxes and handholes provide tags of embossed brass type with cable type and voltage rating. Attach tags to cable with slip-free plastic cable lacing units.

D. Color coding

1. For 120/208 Volt (or 120/240 Volt), 1 phase, 3 wire systems:
  - a. Phase A – Black
  - b. Phase B – Red
  - c. Neutral – White
  - d. Ground – Green
2. For 120/208 Volt, 3 phase, 4 wire systems:
  - a. Phase A – Black
  - b. Phase B – Red
  - c. Phase C – Blue
  - d. Neutral – White
  - e. Ground – Green
3. For 277/480 Volt, 3 phase, 4 wire systems:
  - a. Phase A – Brown
  - b. Phase B – Orange
  - c. Phase C – Yellow
  - d. Neutral – Gray
  - e. Ground – Green
4. Switch leg individually installed shall be the same color as the branch circuit to which they originate, unless otherwise indicated.
5. Travelers for 3-way and 4-way switches shall be a distinct color and pulled with the circuit switch leg or neutral.

3.07 *FIELD QUALITY CONTROL*

- A. Supply labor, materials and test equipment required to perform continuity and ground tests.
- B. Electrical testing
  1. Perform feeder and branch circuit insulation test after installation and prior to connection to device.
  2. Tests shall be performed by 600 Vdc megger for a continuous 10 seconds from phase-to-phase and phase-to-ground.
  3. Torque test conductor connections and terminations for conformance to Specifications.
  4. If any failure is detected, locate failure, determine cause and replace or repair cable to Engineer's satisfaction at no additional costs.
  5. Furnish test results in type written report form for review by Engineer.

**END OF SECTION**

## **SECTION 26 05 26**

### **GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

#### **PART 1 - GENERAL**

##### **1.01 SUMMARY**

###### **A. Section includes**

1. Provide all labor, materials and equipment necessary to complete the installation required for the item specified under this Section, including but not limited to power system grounding

###### **B. Related sections**

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### **1.02 REFERENCES**

###### **A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:**

1. CCR –California Code of Regulations, Title 24
  - a. Part 3 -California Electrical Code (CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. IEEE –Institute of Electrical and Electronic Engineers
  - a. 142; Recommend Practices for Grounding of Industrial and Commercial Power Systems
3. NFPA –National Fire Protection Association
  - a. 780; Lightning Protection Code
4. UL –Underwriters Laboratories, Inc.
  - a. 467; Grounding and Bonding Equipment

##### **1.03 SYSTEM DESCRIPTION**

- ###### **A. This Section provides for the grounding and bonding of all electrical and communication apparatus, machinery, appliances, components, fittings and accessories where required to provide a permanent, continuous, low impedance, grounded electrical system.**

- B. Ground the electrical service system neutral at service entrance equipment as shown on the Drawings.
- C. Ground each separately derived system, as defined in CEC 250.5 (D) and on the Drawings, unless specifically noted otherwise.
- D. Except as otherwise indicated, the complete electrical installation including the neutral conductor, equipment and metallic raceways, boxes and cabinets shall be completely and effectively grounded in accordance with all CEC requirements, whether or not such connections are specifically shown or specified.

#### *1.04 SUBMITTALS*

- A. Submit manufacturer's data for equipment and materials specified within this Section in accordance to Section 26 05 00.

#### *1.05 QUALITY ASSURANCE*

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

### **PART 2 - PRODUCTS**

#### *2.01 CONCRETE ENCASED GROUNDING ELECTRODE (UFER GROUND)*

- A. #3/O AWG minimum bare stranded copper conductor.

#### *2.02 DRIVEN (GROUND) RODS*

- A. Copper clad steel, minimum 3/4" diameter by 10'-0" length, sectional type with copper alloy couplings and carbon steel driving stud; Weaver, Cadweld or equal.

#### *2.03 INSULATED GROUNDING BUSHINGS*

- A. Plated malleable iron body with 150°C molded plastic insulated throat and lay-in ground lug; OZ/Gedney BLG, Thomas & Betts #TIGB series or equal.

#### *2.04 CONNECTION TO PIPE*

- A. Cable to pipe connections; OZ/Gedney G-100B series, Thomas & Betts #290X series or equal.

#### *2.05 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS OR SPICES*

- A. Where required by the Drawings, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds, Cadweld or equal, or high pressure compression type connectors, Cadweld, Thomas & Betts or equal.

#### *2.06 BONDING JUMPERS*

- A. OZ/Gedney Type BJ, Thomas & Betts #3840 series or equal.

## 2.07 GROUND CONDUCTOR

- A. Ground conductor shall be code size UL labeled, Type THWN insulated copper wire, green in color.

## 2.08 MAIN BUILDING REFERENCE GROUND BUS (BGB)

- A. Provide 1 24"x4"x1/4" TK copper bus bar mounted on wall with insulating stand-offs at +18" AFF. Furnish complete with cast copper alloy body Thomas Betts Series 310 or equal lugs for connecting grounding conductors. Attach lugs to bus with appropriate size bronze bolt, flat washer and Belleville washer. All connections shall be torque, and all holes shall be drilled and tapped for single hole lugs. Provide 4 spare lugs with respective spaces.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Grounding electrodes
  - 1. Concrete encased grounding electrode (Ufer ground)
    - a. Provide a #3/O AWG minimum bare copper conductor encased along the bottom of concrete foundation, footing or trench which is in direct contact with the earth and where there is no impervious waterproofing membrane between the footing and soil. The electrode shall extend through a horizontal length of 30' minimum and shall be encased in not less than 2" or more than 5" of concrete separating it from surrounding soil. The electrode shall emerge from the concrete slab through a protective non-metallic sleeve and shall be extended to BGB or as shown on Drawings.
  - 2. Supplementary grounding electrode (ground ring, grid and driven rod)
    - a. Provide as shown driven ground rod(s). Interconnect ground rod with structural steel and adjacent rods with code size bare copper conductor. Ground rods shall be space no less than 6'-0" on centers from any other electrode or electrodes of another electrical system.
  - 3. Separately derived electrical system grounding electrode
    - a. Ground each separately derived system per CEC 250-26 or as shown on Drawings, whichever is greater.
  - 4. Metal underground water pipe
    - a. Contractor shall install an accessible grounding electrode conductor from the main incoming cold water line to BGB. The electrode conductor shall be sized per CEC Table 250-94 or as shown on Drawings, whichever is greater.
- B. Grounding electrode conductor
  - 1. Provide grounding electrode conductors per CEC Table 250-94 or as shown on Drawings, whichever is greater.
- C. Power system grounding



1. Connect the following items using code size copper grounding conductors to BGB or as shown on Drawings:
  - a. Concrete encased electrode (Ufer ground)
  - b. Ground rod(s)
  - c. Incoming cold and fire water pipes
  - d. Gas pipe
  - e. Structural steel
  - f. Distribution transformer secondary

D. Equipment Bonding/Grounding

1. Provide a code sized copper ground conductor, whether indicated or noted on the drawings, in each of the following:
  - a. All power distribution conduits and ducts
  - b. Distribution feeders
  - c. Motor and equipment branch circuits
  - d. Device branch circuits
2. Provide a separate grounding bus at distribution panelboards, loadcenters, switchboards and motor control centers. Connect all metallic enclosed equipment so that with maximum fault current flowing, shall be maintained at not more than 35V above ground.
3. Metallic conduits terminating in concentric, eccentric or oversized knockouts at panelboards, cabinets, gutters, etc. shall have grounding bushings and bonding jumpers installed interconnecting all such conduits.
4. Provide bonding jumpers across expansion and deflection coupling in conduit runs, pipe connections to water meters and metallic cold water dielectric couplings.
5. Provide ground wire in flexible conduit connected at each end via grounding bushing.
6. Provide bonding jumpers across all cable tray joints.
7. Bond each end of metallic conduit longer than 36" in length to grounding conductor using a #6 AWG pigtail.

3.02 *FIELD QUALITY CONTROL*

- A. Contractor using test equipment expressly designed for that purpose shall perform all ground resistance tests in conformance with IEEE guidelines. Contractor shall submit typewritten records of measured resistance values to Engineer for review and approval prior to energizing the system.
- B. Obtain and record ground resistance measurements both from electrical equipment ground bus to the ground electrode and from the ground electrode to earth. Furnish and install additional bonding and add grounding electrodes as required to comply with the following resistance limits:

1. Resistance from ground bus to ground electrode and to earth shall not exceed 5 ohms unless otherwise noted.
  2. Resistance from the farthest panelboard, loadcenter, switchboard or motor control center ground bus to the ground electrode and to earth shall not exceed 20 ohms maximum.
- C. Inspection
1. The Engineer or Inspector prior to encasement, burial or concealment thereto shall review the grounding electrode and connections.

**END OF SECTION**

## **SECTION 26 05 33**

### **RACEWAYS AND BOXES**

#### **PART 1 - GENERAL**

##### **1.01 SUMMARY**

###### **A. Section includes**

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to electrical conduits; outlet, junction and pull boxes; and related supports.

###### **B. Related sections**

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
  - a. 26 05 26 – Grounding and Bonding for Electrical Systems
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### **1.02 REFERENCES**

###### **A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:**

1. ANSI –American National Standards Institute
  - a. C33.91; Specification for Rigid PVC Conduit
  - b. C80.1; Specification Rigid Steel Conduit, Zinc-Coated
  - c. C80.3; Specification for Electrical Metallic Tubing, Zinc-Coated
  - d. C80.6; Intermediate Metal Conduit (IMC), Zinc-Coated
2. CCR –California Code of Regulations, Title 24
  - a. Part 2 -California Building Code (CBC); International Building Code (IBC) with California amendments
  - b. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
3. NECA –National Electrical Contractors Association
  - a. 101, Standard for Installing Steel Conduit (Rigid, IMC, EMT)
  - b. 111, Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) (ANSI)
4. NEMA –National Electrical Manufacturer’s Association

- a. FB 1; Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
  - b. FB 2.10; Selection and Installation Guidelines for Fittings for Use with Non-flexible Electrical Metal Conduit or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, and Electrical Metallic Tubing)
  - c. FB 2.20; Selection and Installation Guidelines For Fittings for Use With Flexible Electrical Conduit and Cable
  - d. OS 1; Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
  - e. OS 3; Selection and Installation Guidelines for Electrical Outlet Boxes
  - f. RN 1; Polyvinyl-Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing
  - g. TC 2; Electrical Plastic Tubing and Conduit
  - h. TC 3; PVC Fittings for Use with Rigid PVC Conduit and Tubing
  - i. TC 14; Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
5. OSHPD Anchorage Pre-approvals
- a. OPA-0003; Superstrut Seismic Restraint System
  - b. OPA-0114; B-Line Seismic Restraints
  - c. OPA-0120; Unistrut Seismic Bracing System
  - d. OPA-0242; Power-Strut Seismic Bracing System
6. UL –Underwriter’s Laboratories, Inc.
- a. 1; Standard for Flexible Metal Conduit
  - b. 6; Rigid Metal Electrical Conduit
  - c. 360; Standard for Liquid-Tight Flexible Steel Conduit
  - d. 514A; Metallic Outlet Boxes, Electrical
  - e. 514B; Fittings for Conduit and Outlet Boxes
  - f. 651; Schedule 40 & 80 PVC Conduit
  - g. 797; Electrical Metallic Tubing
  - h. 1242; Intermediate Metal Conduit
  - i. 1684; Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

### 1.03 SYSTEM DESCRIPTION

- A. Furnish, assemble, erect, install, connect and test all electrical conduits and related raceway apparatus required and specified to form a complete installation.

### 1.04 SUBMITTALS

- A. Submit manufacturer’s data for materials specified within this Section in accordance to Section 26 05 00.

### 1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.
- B. Installation shall conform to the NECA installation guidelines unless otherwise indicated within this Section

## PART 2 - PRODUCTS

### 2.01 MATERIALS

#### A. Conduits and Fittings

##### 1. Rigid steel conduit (RMC)

- a. Conduit: Standard weight, mild steel pipe, and zinc coated on both inside and outside by a hot dipping or shearardizing process manufactured in accordance with UL 6 and ANSI C80.1 specifications.
- b. Fittings (couplings, elbows, bends, etc.)
  - 1) Shall be steel or malleable iron.
  - 2) Coupling and unions shall be threaded type, assembled with anti-corrosion, conductive and anti-seize compound at joints made absolutely tight to exclude water.
- c. Bushings
  - 1) Insulating bushings: Threaded polypropylene or thermosetting phenolic rated at 150°C minimum.
  - 2) Insulating grounding bushing: Threaded cast body with insulating throat and steel “lay-in” ground lug.
  - 3) Insulating metallic bushing: Threaded cast body with plastic insulated throat rated at 150°C minimum.

##### 2. Stainless steel conduit (SSC)

- a. Conduit: Same as rigid steel conduit except Type 304 stainless steel.
- b. Fittings (couplings, elbows, bends, etc.): Same as rigid steel conduit except Type 304 stainless steel.
- c. Bushings: Same as rigid steel conduit except Type 304 stainless steel.

##### 3. Coated rigid steel conduit (CRMC)

- a. Conduit: Equivalent to RMC with a Polyvinyl chloride (PVC) coated bonded to the galvanized outer surface of the conduit. The bonding between the PVC coating and conduit surface shall be ETL PVC-001 compliant. The coating thickness shall be a minimum of 40mil.
- b. Fittings (couplings, elbows, bends, etc.)
  - 1) Equivalent to RMC above with bonded coating same as conduit.

- 2) The PVC sleeve over fittings shall extend beyond hub or coupling approximately one diameter or 1 1/2" whichever is smaller.
- c. Bushing equivalent to RMC above.
4. Intermediate metallic conduit(IMC)
  - a. Conduit: Intermediate weight, mild steel pipe, meeting the same requirements for finish and material as rigid steel conduit manufactured in accordance with UL 1242 and ANSI C80.6 specifications.
  - b. Fittings (couplings, elbows, bends, etc.) equivalent to RMC above.
  - c. Bushing equivalent to RMC above.
5. Electrical metallic tubing (EMT)
  - a. Conduit: Cold rolled steel tubing with zinc coating on outside and protective enamel on inside manufactured in accordance with UL 797 and ANSI C80.3 specifications.
  - b. Couplings: Steel or malleable iron with compression type fastener via a nut.
  - c. Connectors: Steel or malleable iron with compression type fastener via a nut with plastic insulated throat rated at 150°C minimum.
6. Rigid non-metallic conduit (PVC)
  - a. Conduit: PVC composed Schedule 40, 90°C manufactured in accordance with NEMA TC 2 and UL 651 specifications.
  - b. Fittings: Molded PVC, slip on solvent welded type in accordance to NEMA TC 3.
7. Reinforced thermosetting resin conduit (RTRC)
  - a. Conduit: Fiber impregnated with a cured thermosetting resin compound in accordance with NEMA TC 14 and UL1684.
  - b. Fittings: Molded resin with glass reinforcement manufactured in the same process as the conduit bonded with an epoxy adhesive.
8. Flexible metallic conduit (FMC)
  - a. Conduit: Continuous, flexible steel spirally wound with zinc coating on both inside and outside in accordance with UL 1.
  - b. Connectors: Steel or malleable iron with compression type fastener via a nut with plastic insulated throat rated at 150°C minimum.
9. Liquidtight flexible metallic conduit (LFMC)
  - a. Conduit: PVC coated, continuous, flexible steel spirally wound with zinc coating on both inside and outside in accordance with UL 360.
  - b. Connectors: Steel or malleable iron with compression type fastener via a nut with plastic insulated throat rated at 150°C minimum.
10. Miscellaneous Fittings and Products
  - a. Conduit sealing bushings: Steel or cast malleable iron body and pressure clamps with PVC sleeve, neoprene sealing grommets and PVC coated steel

pressure rings. Supplied with neoprene sealing rings between body and PVC sleeve.

- b. Watertight cable terminators: One piece, compression molded sealing ring with PVC coated steel pressure disks, stainless steel screws and zinc plated cast iron locking collar.
- c. Watertight cable/cord connectors: Liquidtight steel or cast malleable iron body with sealing neoprene bushing and stainless steel retaining ring.
- d. Expansion fittings: Multi-piece unit of hot dip galvanized malleable iron or steel body and outside pressure bussing design to allow a maximum of 4" movement (2" in either direction). Furnish with external braid tinned copper bonding jumper. UL listed for both wet and dry locations.
- e. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve, internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling to provide minimum of 3/4" movement and 30 degrees deflection from normal. UL listed for both wet and dry locations.
- f. Conduit bodies: Raintight, malleable iron, hot-dip galvanized body with threaded hubs, stamped steel cover, stainless steel screws and neoprene gasket.
- g. Other couplings, connectors and fittings shall be equal in quality, material and construction to items specified herein.

## B. Boxes

### 1. Outlet boxes

- a. Standard: Galvanized one-piece of welded pressed steel type in accordance with NEMA OS 1 and UL 514. Boxes shall not be less than 4" square and at least 1 1/2" deep.
- b. Concrete: Galvanized steel, 4" octagon ring with mounting lug, backplate and adapter ring type in accordance with NEMA OS 1 and UL 514. Depth as required by application.
- c. Masonry: Galvanized steel, 3.75" high gang box in accordance with NEMA OS 1 and UL 514.
- d. Surface cast metal: Cast malleable iron body, surface mounted box with threaded hubs and mounting lugs as required in accordance with NEMA OS 1 and UL 514. Furnish with ground flange, steel cover and neoprene gasket.

### 2. Pull and junction boxes

- a. Sheet metal boxes: Standard or concrete outlet box wherever possible; otherwise use 16 gauge galvanized sheet metal, NEMA 1 box sized per CEC with machine screwed cover.
- b. Cast metal boxes: Install standard cast malleable iron outlet or device box when possible.
- c. Flush mounted boxes: Install overlapping cover with flush head screws.

- d. In-ground mounted pull holes/boxes: Install pre-cast concrete box, sized per Drawing or CEC with pre-cast or traffic rated lid.
3. Floor boxes
  - a. Floor boxes shall be adjustable, cast metal body with threaded conduit openings, adjustable rings, brass flange or Lexan ring and cover plate with threaded plug. Include provisions to accommodate surface mounted telephone or receptacle outlet, or flush floor mounted telephone or receptacle outlet where shown on Drawings.
- C. Pull line/cord
  1. Polypropylene braided line or Let-line #232 or equal of 1/8" diameter with a minimum break strength of 200 pounds.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Thoroughly examine site conditions for acceptance of wire and cable installation to verify conformance with manufacturer and specification tolerances. Do not commence with work until all conditions are made satisfactory.

#### **3.02 PREPARATION**

##### **A. Conduit**

1. Provide all necessary conduit fittings, connectors, bushings, etc. required to complete conduit installation to meet the CEC and intended application whether noted, shown or specified within.
2. Location of conduit runs shall be planned in advance of the installation and coordinated with other trades.
3. Where practical, install conduits in groups in parallel vertical or horizontal runs that avoid unnecessary offsets.
4. All conduits shall be parallel or at right angles to columns, beams and walls whether exposed or concealed.
5. Conduits shall not be placed closer than 12" to a flue, parallel to hot water, steam line or other heat sources; or 3" when crossing perpendicular to the above said lines when possible.
6. Install exposed conduit as high as practical to maintain adequate headroom. Notify Engineer if headroom will be less than 102".
7. Do not obstruct spaces required by Code in front of electrical equipment, access doors, etc.
8. The largest trade size conduit in concrete floors and walls shall not exceed 1/3 thickness or be spaced a less than three conduit diameters apart unless permitted by Engineer. All conduits shall be installed in the center of slab or wall, and never between reinforcing steel and bottom of floor slab.



9. Install additional pull boxes, not shown on Drawings, in sufficient quantities to facilitate pulling of conductors and cables such that total spacing does not exceed 150 feet or 270 degrees, total; and maximum pulling tension will not be exceeded.
10. When installing underground conduits to specified depth; depth shall be taken from finished grade as it will be at project completion. Should finish grade be above existing grade by an amount equal to or greater than specified depth, conduit shall be installed not less than 6" below existing grade.
11. Verify that information concerning finish grade is accurate, for should the underground run be less than the specified depth, Contractor may be required to re-install conduit to meet the required depth.
12. Unless otherwise specified, underground conduits shall be installed with top side not less than 24" below finished grade; this depth applies to all conduits outside of building foundations including those under walks, open corridors or paved areas.
13. Utility company service conduits installation depth shall be as directed by their respective specifications and requirements.

#### B. Boxes

1. Before locating outlet boxes, check Construction Documents for type of construction and make sure that there is no conflict with other equipment. Locate outlet boxes as shown and locate so as not to interfere with other Work or equipment.
2. Install all outlet boxes flush within walls, ceiling and floors except where installed within non-finished rooms, cabinetry, attic spaces or as indicated on Drawings.
3. Locate pull boxes and junction boxes within concealed, accessible locations where possible.
4. Do not install outlet boxes back-to-back with same stud space. Where shown back-to-back, offset as required, and fill void with sound dampening material where requested by Owner.
5. In fire rated walls separate boxes by 24" minimum and with stud member.
6. Adjust position of outlet boxes within masonry wall to accommodate course lines.

### 3.03 *INSTALLATION*

#### A. Conduit

1. Minimum conduit size shall be 3/4" unless otherwise indicated.
2. All conduit work shall be concealed unless otherwise indicated. Exposed conduits shall be permitted within unfinished rooms/spaces to facilitate installation.
3. Install conduit in complete runs prior to installing conductors or cables.
4. Make long radius conduits bends free from kink, indentations or flattened surfaces. Make bends carefully to avoid injury or flattening. Bends 1 1/4" size and larger shall be factory made ells, or be made with a manufactured

mechanical bender. Heating of steel conduit to facilitate bending or that damage galvanized coating will not be permitted.

5. Remove burrs and sharp edges at end of conduit with tapered reamer.
6. Protect and cover conduits during construction with metallic bushings and bushing “pennies” to seal exposed openings.
7. Assemble conduit threads with anti-corrosion, conductive, anti-seize compound and tighten securely.
8. Install conduits shall that no traps to collect condensation exist.
9. Fasten conduit securely to boxes with locknuts and bushings to provide good grounding continuity.
10. Install pull cords/line within any spare or unused conduits of sufficient length to facilitate future cable installation.
11. Penetrations
  - a. Locate penetrations within structural members as shown on Drawings and as directed by Engineer. Should it be necessary to notch any framing member, make such notching only at locations and in a manner as approved by Engineer.
  - b. Do not chase concrete or masonry to install conduit unless specifically approved by Engineer.
  - c. Cutting or holes
    - 1) Install sleeves for cast-in-place concrete floors and walls. After installing conduit through penetration, seal using dry-pack grouting compound (non-iron bearing, chloride free and non-shrinking) or fire rated assembly if rated floor or wall. Use escutcheon plate on floor underside to contain compound as necessary.
    - 2) Cut holes with a hole saw for penetrations through non-concrete or non-masonry members.
    - 3) Provide chrome plated escutcheon plates at all publicly exposed wall, ceiling and floor penetrations.
  - d. Sealing
    - 1) Non-rated penetration openings shall be packed with non-flammable insulating material and sealed with gypsum wallboard taping compound.
    - 2) Fire rated penetration shall be sealed using a UL classified fire stop assembly suitable to maintain the equivalent fire rating prior to the penetration.
    - 3) Use escutcheon plates to hold sealing or fire rated compound as necessary.
  - e. Waterproofing
    - 1) Make penetrations through any damp-proofed/waterproofed surfaces within damp/wet locations as such as to maintain integrity of surface.

- 2) Install specified watertight conduit entrance seals at all below grade wall and floor penetrations.
- 3) At roof penetrations furnish roof flashing, counter flashing and pitch-pockets compatible to roof assembly.
- 4) Where possible conduits that horizontally penetrate a waterproof membrane shall fall away from and below the penetration's exterior side.
- 5) Make penetrations through floors watertight with mastic, even when concealed within walls or furred spaces.

## 12. Supports

- a. Conduits shall be support and braced per OSHPD pre-approved anchorage systems when those methods are implemented and installed.
- b. Sizes of rods and cross channels shall be capable of supporting 4 times and 5 times actual load, respectively. Anchorage shall support the combined weight of conduit, hanger and conductors.
- c. Support individual horizontal conduit 1 1/2" and smaller by means of 2 hole straps or individual hangers.
- d. Galvanized iron hanger rods sizes 1/4" diameter and larger with spring steel fasteners, clips or clamps specifically design for that purpose for 1 1/2" conduits and larger.
- e. Support multi-parallel horizontal conduits runs with trapeze type hangers consisting of 2 or more steel hanger rods, preformed cross channels, 'J' bolts, clamps, etc.
- f. Support conduit to wood structures by means of bolts or lag screws in shear, to concrete by means of insert or expansion bolts and to brickwork by means of expansion bolts.
- g. Support multi-parallel vertical conduits runs with galvanized Unistrut, Power-Strut or approved equal type supports anchored to wall. Where multi-floored conduits pass through floors, install riser clamps at each floor.
- h. Maximum conduit support spacing shall be in accordance with NECA Standard of Installation:
  - 1) Horizontal runs:
    - a) 3/4" and smaller at 60" on centers, unless building construction prohibits otherwise, then 84" on centers.
    - b) 1" and larger at 72" on centers, unless building construction prohibits otherwise or any other condition, then 120" on centers.
  - 2) Vertical runs:
    - a) 3/4" and smaller @ 84" on centers.
    - b) 1" and 1 1/4" @ 96" on centers.
    - c) 1 1/2" and larger @ 120" on centers.

d) Any vertical condition such as shaftways and concealed locations for any sized conduit, 120" on centers.

i. Anchorage for RMC/IMC supports unless otherwise specified:

- 1) < 1" IMC/RMC = #10 bolt/screw.
- 2) 1" IMC/RMC = 1/4" bolt/screw.
- 3) 1 1/2" and 2" IMC/RMC = 3/8" bolt/screw.
- 4) 3" IMC/RMC, 4" EMT = 1/2" bolt/screw.
- 5) > 3"IMC/RMC = 5/8" bolt/screw.

j. Anchorage for EMT supports unless otherwise specified:

- 1) < 1 1/2" EMT = #10 bolt/screw.
- 2) 1 1/2" EMT = 1/4" bolt/screw.
- 3) 2, 2 1/2" and 3" EMT = 3/8" bolt/screw.
- 4) 4" EMT = 1/2" bolt/screw.
- 5) > 4"EMT = 5/8" bolt/screw.

#### B. Boxes

1. Install boxes as shown on Drawings and as required for splices, taps, wire pulling, equipment connections and Code compliance.
2. Install additional pull boxes, not shown on Drawings, in sufficient quantities to facilitate pulling of conductors and cables such that total spacing does not exceed 150 feet or 270 degrees, total; and maximum pulling tension will not be exceeded.
3. Install plaster rings on all outlet boxes in stud walls or in furred, suspended or exposed ceilings. Covers shall be of a depth suited for installation.
4. Provide gasketed cast metal cover plates where boxes are exposed in damp or wet locations
5. Install access door for boxes installed within concealed locations without access.
6. Install approved factory made knockout seal where knockouts are not present.
7. Refer to Architectural interior elevations and details shown for exact mounting heights of all electrical outlets. In general, locate outlets as shown or specific and complies with Americans with Disabilities Act:
  - a. Convenience outlets: +18"AFF or +6" above counter or splash.
  - b. Local switches: +48"AFF or +6" above counter or splash.
  - c. Telecommunication outlets: +18"AFF or +48"AFF for wall telephone or intercom device.
  - d. Verify all mounting heights with Drawings, and where heights are not suited for construction or finish please consult Engineer.
8. Use conduit bodies to facilitate pulling of conductor or cables or change conduit direction. Do not splice within conduit bodies.

9. Enclose pull box with additional rated gypsum board as necessary to maintain wall's original fire rating.
10. Install galvanized steel coverplates on all open boxes within dry listed areas.
11. Install in-ground pull holes/boxes flush to grade finish at finished areas or 1" above finished landscaped grade. Seal all conduits terminating in pull hole/box watertight. Install and grout around bell ends where shown. Cover and lids shall be removable without damage to adjacent finish surfaces.
12. Support
  - a. Accurately place boxes for finish, independently and securely supported by adequate blocking or manufacturer channel type heavy-duty box hangers for stud walls. Do not use nails to support boxes.
  - b. Support boxes independent of conduit system.
  - c. Mount boxes installed within ceilings to 16 gauge metal channel bars attached to main runners or joists.
  - d. Support boxes within suspended acoustical tile ceilings directly from structure above when light fixture are to be installed from box.
  - e. Use auxiliary plates, bar or clips and grouted in place for masonry, block or pour-in-place concrete construction.

### 3.04 APPLICATION

#### A. Conduit

1. RMC/IMC suitable for all damp, dry and wet locations except when in contact with earth. IMC not suitable for hazardous locations as stated within CEC.
2. CRMC suitable for damp or wet locations, concealed within concrete or in contact with earth.
3. EMT suitable for exposed or concealed dry, interior locations.
4. PVC/RTRC suitable for beneath ground floor slab, except when penetrating, and direct earth burial. Do not run exposed within concrete walls or in floor slab unless indicated on Drawings or per Engineer's permission.
5. FMC suitable for dry locations only for connections to motors, transformers, vibrating equipment/machinery, controllers, valves, switches and light fixtures in less than 6 foot lengths.
6. LFMC application same as FMC above but for damp or wet locations.

#### B. Termination and joints

1. Use raceway fittings compatible with associated raceway and suitable for the location.
2. Raceways shall be joined using specified couplings or transitions where dissimilar raceway systems are joined.
3. Conduits shall be securely fastened to cabinets, boxes and gutters using (2) two locknuts and insulating bushing or specified insulated connector. Where joints cannot be made tight and terminations are subject to vibration, use bonding

jumpers, bonding bushings or wedges to provide electrical continuity of the raceway system. Use insulating bushings to protect conductors where subjected to vibration or dampness. Install grounding bushings or bonding jumpers on all conduits terminating at concentric or eccentric knockouts.

4. Terminations exposed at weatherproof enclosures and cast outlet boxes shall be made watertight using specified connectors and hubs.
5. Stub freestanding equipment conduits through concrete floors for connections with top of coupling set flush with finished floor. Install plugs to protect threads and entrance of debris.
6. Install specified cable sealing bushings on all conduits originating outside the building walls and terminating within interior switchboard, panel, cabinet or gutters. Install cable sealing bushings or raceway seal for conduit terminations in all grade level or below grade exterior pull, junction or outlet boxes.
7. Where conduits enter building from below grade inject into filled raceways pre-formulated rigid 2 lbs. density polyurethane foam suitable for sealing against water, moisture, insects and rodents.
8. Install expansion fitting or expansion/deflection couplings per manufacturer's recommendations where:
  - a. Any conduit that crosses a building structure expansion joint; secure conduit on both sides to building structure and install expansion fitting at joint.
  - b. Any conduit that crosses a concrete expansion joint; install expansion/deflection at joint.
  - c. Any conduit greater than 1-1/4" is routed along roof top in runs greater than 100 feet; install expansion fittings every 100 feet.
  - d. Engineer may allow FMC or LFMC in lieu of expansion fitting or expansion/deflection couplings on conduits 2" and smaller within accessible locations upon further review and written consent.

#### C. Boxes

1. Standard type suitable for all flush installations and all dry concealed locations.
2. Concrete type suitable for all flush concrete installations.
3. Masonry type suitable for all flush concrete and block installations.
4. Surface cast meta type suitable for all exposed damp and wet surface mounted locations, and dry surface mounted locations less than 96" from finished floor

**END OF SECTION**

## SECTION 26 05 53

### ELECTRICAL IDENTIFICATION

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section includes requirements for:
  - 1. Identifying electrical, instrumentation, and process equipment and components.
  - 2. Material, manufacturing, and installation requirements for identification devices.
- B. Related Sections:
  - 1. Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the CONTRACTOR and its subcontractors to review all sections to ensure a complete and coordinated project.

##### 1.02 REFERENCES

- A. Refer to Section 26 05 00.

##### 1.03 DEFINITIONS

- A. Refer to Section 26 05 00.

##### 1.04 SYSTEM DESCRIPTION

- A. Nameplates:
  - 1. Provide a nameplate for each control device or major item of electrical equipment, either located in the field or within panels.
  - 2. Provide all nameplates of identical style, color, and material throughout the facility.
  - 3. Device nameplates information:
    - a. Designations as indicated on the Drawings and identified on the Process and Instrumentation Drawings.
    - b. Device tag and loop number ID (e.g. EDV-60.0101.01).
    - c. Circuit ID (e.g. LPA-11).
    - d. Area served (e.g. Lighting Chemical Building).
- B. Wire Numbers:
  - 1. Coordinate the wire numbering system with all vendors of equipment so that every field wire has a unique number associated with it for the entire system:
    - a. Wire numbers shall correspond to the wire numbers on the control drawings or the panel and circuit numbers for receptacles and lighting.
    - b. Wire numbers shall correspond to the terminal block number to which they are attached in the control panel.
    - c. Internal panel wires on a common terminal shall have the same wire number.

- d. All instrumentation cables shall be identified at pull points as described above.
2. Provide the following wiring numbering schemes throughout the project for field wires between Process Control Module, (PCM), Vendor Control Panels, (VCP), Motor Control Centers, (MCC), field starters, field instruments, etc.

(ORIGIN LOC.)–(ORIGIN TERM.)/(DEST. LOC.)–(DEST. TERM.)

O  
R

(ORIGIN LOC.)–(ORIGIN TERM.)  
(DEST. LOC.)–(DEST. TERM.)

Where:

ORIGIN LOC. = Designation for originating panel or device  
ORIGIN TERM. = Terminal designation at originating panel or device  
DEST. LOC. = Designation for destination panel or device  
DEST. TERM. = Terminal designation at destination panel or device or PLC I/O  
address at destination panel

- a. Identify equipment and field instruments as the origin.  
b. PCM's are always identified as the destination.  
c. Location is the panel designation for VCP, LCP, or PCM. For connections to MCC's, location is the specific starter tag and loop number. Location is the tag and loop number for motor starters, field instruments and equipment. Any hyphen in the panel designation or tag and loop number shall be omitted.  
d. Terminal designation is the actual number on the terminal block where the conductor terminates at field devices and vendor control panels. For multiconductor cables, all terminal numbers shall be shown, separated by commas.  
e. Terminal designations at motor leads shall be the motor manufacturer's standard terminal designation (e.g.T1, T2, T3, etc.).  
f. Terminal designations at PCM's where the field conductor connects to a PLC input or output shall be the PLC address (Note: the following PLC I/O numbering scheme is typical for Allen Bradley, the numbering scheme should be modified to match that of the actual PLC manufacturer used for the project):  
1) Discrete Point: W:X:Y/Z  
Analog Point: W:X:Y.Z

Where:

W = I for input, O for output

X = PLC number (1, 2, 3...)

Y = Slot number (01, 02, 03...)

Z = Terminal number (00,01,02...) for a discrete point



- or a word number for an analog point (1,2,3...)
- g. Terminal designations at PCM's where the conductor does not connect to a PLC I/O point shall be the terminal number with a "C" prefix (e.g. 010). For common power after a fuse or neutrals after a switch, the subsequent points shall have and capital letter suffix starting with "A" (e.g.. C0010A).
3. **Case 1:** Vendor Control Panel (VCP) to Process Control Module (PCM):  
Field Wire Number/Label: A-B/C-D  
A = Vendor Control Panel number without hyphen (VCP60.0101.01)  
B = Terminal number within VCP (manufacturer's or vendor's standard terminal number)  
C = Process Control Module number without hyphen (PCM60.0101)  
D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)
- Examples: VCP60.0101.01-10/PCM60.0101-I:1:01/01  
VCP60.0101.01-10/PCM60.0101-O:1:10/07  
VCP60.0101.01-10/PCM60.0101-C0100
4. **Case 2:** Field Instrument to Process Control Module (PCM): Field Wire Number/Label: E-F/C-D  
C = Process Control Module number without hyphen (PCM60.0101)  
D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)  
E = Field mounted instrument tag and loop numbers without hyphen (EDV60.0101.01)  
F = Manufacturer's standard terminal number within instrument. Use both terminal numbers for analog points separated by a comma
- Examples: TIT60.0101.01-2,3/PCM60.0101-I:1:01.1  
TSH60.0101-1/PCM60.0101-I:2:01/00
5. **Case 3:** Motor Control Center (MCC) to Process Control Module (PCM): Field Wire Number/Label: G-B/C-D  
B = Terminal number within Motor Control Center (manufacturer's or vendor's standard terminal number)  
C = Process Control Module without hyphen (PCM60.0101)  
D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)  
G = Actual starter designation in the Motor Control Center without hyphen (MMS60.0101)
- Examples: MMS60.0101-10/PCM60.0101-I:1:01/01  
MMS60.0101-10/PCM60.0101-O:1:10/07  
MMS60.0101-10/PCM60.0101-C0100
6. **Case 4:** Motor Control Center (MCC) to Vendor Control Panel

(VCP): Field Wire Number/Label: G-B/A-B  
A = Vendor Control Panel number without hyphen (VCP60.0101.01)  
B = Terminal number within motor control center or vendor control panel  
(manufacturer's or vendors standard terminal number)  
G = Actual starter designation in the Motor Control Center without hyphen  
(MMS60.0101)

Example: MMS60.0101-X2/VCP60.0101.01-10

7. **Case 5:** Motor leads to a Motor Control Center (MCC): Field Wire Number/Label: H-I/G-B  
B = Terminal number within motor control center (manufacturer's standard terminal number)  
G = Actual starter designation in the Motor Control Center without hyphen (MMS60.0101)  
H = Equipment tag and loop number without hyphen (PMP60.0101.01)  
I = Motor manufacturer's standard motor lead identification (e.g.T1, T2, T3, etc.)

Example: PMP-60.0101.01-T3/MMS60.0101.01-T3

8. **Case 6:** Remote or separately mounted starter or Variable Frequency Drive (VFD) to Process Control Module (PCM): Field Wire Number/Label: J-B/C-D  
B = Terminal number within starter or Variable Frequency Drive (manufacturer's standard terminal number)  
C = Process Control Module number without hyphen (VCP60.0101.01)  
D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)  
J = Starter or Variable Frequency Drive tag and loop number without hyphen (MMS60.0101)

Examples: MMS60.0101-10/PCM60.0101.01-I:1:01/01  
MMS60.0101-10/PCM60.0101.01-O:2:10/07  
MMS60.0101-10/PCM60.0101.01-C0010

9. Terminate all spare conductors on terminal blocks and identify as required for other field wires with an "S" prefix:

Example: S MMS60.0101-10/PCM60.0101.01-C011

### 1.05 SUBMITTALS

- A. Furnish submittals in accordance with Section 26 05 00.
- B. Product Data:
1. Nameplates:
    - a. Color.
    - b. Size:
      - 1) Outside dimensions.
      - 2) Lettering.

- c. Material.
    - d. Mounting means.
  - 2. Nameplate Schedule:
    - a. Show exact wording for each nameplate.
    - b. Include nameplate and letter sizes.
  - 3. Wire Numbers:
    - a. Manufacturer's catalog data for wire labels and label printer.
- C. Record Documents:
  - 1. Update the conduit schedule to reflect the exact quantity of wire numbers including spares and destination points for all wires.

#### **1.06 QUALITY ASSURANCE**

- A. Schedule a pre-installation conference in accordance with Section 26 05 00 in order to clearly define the requirements specified for equipment identification:
  - 1. Representatives of the CONTRACTOR, OWNER, and ENGINEER shall convene before any major purchases of cable or conductors and before the installation or termination of any cables or conductors.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Refer to Section 26 05 00.

#### **1.08 WARRANTY**

- A. Refer to Section 26 05 00.

#### **1.09 SYSTEM START UP**

- A. Refer to Section 26 05 00.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Nameplates and Signs:
  - 1. One of the following or equal:
    - a. Brady.
    - b. Seton.
- B. Conductor and Cable Markers:
  - 1. Heat-shrinkable tubing:
    - a. One of the following or equal:
      - 1) Raychem.
      - 2) Brady.
      - 3) Thomas & Betts.
      - 4) Kroy.

- C. Conduit and Raceway Markers:
  - 1. One of the following or equal:
    - a. Almetek: Almetek type mini-tag.
    - b. Lapp Group: Maxi System
- D. Medium Voltage Raceway Voltage Labels:
  - 1. One of the following or equal:
    - a. Brady.
    - b. Seton.

## 2.02 MATERIALS

- A. Nameplates:
  - 1. Fabricated from white-center and red or black face laminated plastic engraving stock:
    - a. 3/32-inch thick material.
    - b. Two-ply.
    - c. With chamfered edges.
    - d. Block style engraved characters of adequate size to be read easily from a distance of 6 feet:
      - 1) No characters smaller than 1/8-inch in height.
- B. Signs:
  - 1. Automatic equipment and high voltage signs:
    - a. Suitable for exterior use.
    - b. In accordance with OSHA regulations.
- C. Conductor and Cable Markers:
  - 1. Machine printed black characters on white tubing.
  - 2. Ten point type or larger.
- D. Conduit and Raceway Markers:
  - 1. UV resistant holder and letters.
  - 2. Black letters on yellow background.
  - 3. Minimum 1/2-inch high letters.
- E. Medium Voltage Circuit Raceway Labels:
  - 1. Vinyl plastic.
  - 2. Minimum 1-inch high letters.

## 2.03 SOURCE QUALITY CONTROL

- A. Nameplates:
  - 1. Provide all nameplates for control panel operator devices (e.g. pushbuttons, selector switches, pilot lights, etc.):
    - a. Same material and same color and appearance as the devicenameplates, in order to achieve an aesthetically consistent and coordinated system.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Refer to Section 26 05 00.
- B. Nameplates:
  - 1. Attach nameplates to equipment with rivets, bolts or sheet metal screws, approved waterproof epoxy-based cement or install in metal holders welded to the equipment.
  - 2. On NEMA 4 or NEMA 4X enclosures, use epoxy-based cement to attach nameplates.
  - 3. Nameplates shall be aligned and level or plumb to within 1/64 inch over the entire length:
    - a. Misaligned or crooked nameplates shall be remounted, or provide new enclosures at the discretion of the ENGINEER.
- C. Conductor and Cable Markers:
  - 1. Apply all conductor and cable markers before termination.
  - 2. Heat-shrinkable tubing:
    - a. Tubing shall be shrunk using a heat gun that produces low temperature heated air.
    - b. Tubing shall be tight on the wire after it has been heated.
    - c. Characters shall face the open panel and shall read from left to right or top to bottom.
    - d. Marker shall start within 1/32 inch of the end of the stripped insulation point.
- D. Conduit Markers:
  - 1. Furnish and install conduit markers for every conduit in the electrical system that is identified in the conduit schedule or part of the process system:
    - a. Conduit markings shall match the conduit schedule; refer to Section 26 05 53.
  - 2. Mark conduits at the following locations:
    - a. Each end of conduits that are greater than 10 feet in length.
    - b. Where the conduit penetrates a wall or structure.
    - c. Where the conduit emerges from the ground, slab, etc.
    - d. The middle of conduits that are 10 feet or less in length.
  - 3. Mark conduits after the conduits have been fully painted.
  - 4. Position conduit markers so that they are easily read from the floor.
  - 5. Secure all conduit markers with nylon cable ties:
    - a. Provide with ultraviolet resistant cable ties for conduit markers exposed to direct sunlight.
    - b. Adhesive labels are not acceptable.
  - 6. Mark conduits before construction review by ENGINEER for punch list purposes.
- E. Medium Voltage Raceway Labels:
  - 1. Apply at 50 foot intervals stating the voltage level contained within the raceway.
- F. Signs and Labeling:

1. Furnish and install permanent warning signs at mechanical equipment that may be started automatically or from remote locations:
  - a. Fasten warning signs with round head stainless steel screws or bolts.
  - b. Locate and mount in a manner to be clearly legible to operations personnel.
2. Furnish and install permanent and conspicuous warning signs on equipment (front and back), doorways to equipment rooms, pull boxes, manholes, etc. where the voltage exceeds 600 volts.
3. Furnish and install warning signs on equipment that has more than one source of power.
  - a. Warning signs to identify every panel and circuit number of the disconnecting means of all external power sources.
4. Place warning signs on equipment that has 120 VAC control voltage source used for interlocking.
  - a. Identify panel and circuit number or conductor tag for control voltage source disconnecting means.

### *3.02 FIELD QUALITY CONTROL*

- A. Replace any nameplates, signs, conductor markers, cable markers, or raceway labels that in the sole opinion of the ENGINEER do not meet the ENGINEER's aesthetic requirements.

**END OF SECTION**

## SECTION 26 09 23

### LIGHTING CONTROL DEVICES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to non-networked lighting control devices.

###### B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 REFERENCES

###### A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
  - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. NEMA –National Electrical Manufacturer’s Association
  - a. ICS 1; Industrial Control and Systems: General Requirements
  - b. ICS 6; Industrial Control and Systems: Enclosures
3. UL -Underwriters Laboratories, Inc.
  - a. 50; Cabinets and Boxes
  - b. 508; Standard for Industrial Control Equipment
  - c. 773A; Standard for Nonindustrial Photoelectric Switches for Lighting Control
  - d. 916; Standard for Energy Management Equipment

##### 1.03 SYSTEM DESCRIPTION

###### A. Lighting Control Devices

1. Devices include occupancy sensors and automatic time clock line voltage devices.

##### 1.04 SUBMITTALS

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.
- B. Operating, maintenance and instruction manuals shall be furnished in accordance with General Conditions and Section 26 05 00.
- C. Operating instruction manuals outlining the step-by-step procedures required for system start-up and operation shall be furnished. The instructions shall include manufacturer's name, model number, service manual parts list, and brief description of all equipment and their basic operating features.
- D. Maintenance instruction manuals outlining maintenance procedures shall be furnished. The manual shall include a troubleshooting guide listing possible breakdowns and repairs and a simplified connection wiring diagram for the system as installed.

#### 1.05 *QUALITY ASSURANCE*

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

#### 1.06 *DELIVERY, STORAGE AND HANDLING*

- A. Handle carefully to avoid damage to internal components, enclosure and finish.
- B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

#### 1.07 *WARRANTY*

- A. Furnish guarantee in accordance with and in form required under Section 26 05 00.

#### 1.08 *SYSTEM STARTUP*

- A. Refer to manufacturer's documentation to start-up procedures and requirements.

### **PART 2 - PRODUCTS**

#### 2.01 *LIGHTING CONTROL DEVICES*

- A. General
  - 1. Dual voltage rated for 120 and 277Vac.
  - 2. Compatible with all electronic ballasts, incandescent and motor rated type loads.
  - 3. Utilizes advance electronic circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.
  - 4. All devices shall have a LED or LCD indicating light.
  - 5. All switches shall fit behind a decorator style faceplate.
- B. Occupancy Wall Switches
  - 1. Digital Time Wall Switch



- a. Manufacturers
  - 1) Hubbell TD200, WattStopper TS-400 or approved equal.
- b. General
  - 1) The digital time switch shall be programmable to turn lights off after a preset time and capable of operating as an ON/OFF switch.
  - 2) Time switch shall have no minimum load requirement and shall be capable of controlling 800W at 100/120Vac, 1,200W at 230/277Vac, and 1/6 hp at 125Vac.
  - 3) Time scroll feature shall allow manual overriding of the preset time-out period.
  - 4) Time switch shall have the option for audible and visual alerts 1 minute prior to timeout.
  - 5) Time switch shall have an LCD that shows the timer's countdown.
  - 6) Time-out period shall be adjustable in settings of
    - a) 5, 15, and 30 minutes.
    - b) 1, 3, 6, 9, and 12 hours.
2. Multi-Technology Wall Switch (Infrared and Ultrasonic Technologies)
  - a. Manufacturers
    - 1) Hubbell LHMT or approved equal (no known equal).
  - b. General
    - 1) The passive adaptive infrared and ultrasonic wall switch sensor shall be a self contained control system that replaces a standard toggle switch.
    - 2) Microprocessor technology shall be utilized to avoid false ON activations and to provide high sensitivity to minor occupant motion by detecting infrared energy changes and doppler shifts in transmitted ultrasound within the controlled space.
    - 3) Infrared sensor shall utilize a temperature compensated, dual element sensor and a multi-element fresnel lens.
    - 4) Ultrasonic sensor shall utilize a 40kHz signal.
    - 5) Sensor shall cover up to 1,000SF for walking motion, with a field of view of 180 degrees.
    - 6) Sensor shall be capable of controlling 600W at 100/120Vac and 1,200W at 230/277Vac electronic ballasts and incandescent loads.
    - 7) Sensor shall have a built-in adjustable light level feature that holds load off when a desired footcandle level is present.
    - 8) Sensor shall timeout at 8 minutes initially and will self-adjust based on occupancy.
3. Multi-Technology, Dual Circuit Wall Switch (Infrared and Ultrasonic Technologies)

- a. Manufacturers
    - 1) Hubbell LHMTD2 or approved equal (no known equal).
  - b. General
    - 1) Same as the Multi-Technology Wall Switch above, but with dual input, independent circuit switching capability.
4. Automatic Wall Switch (Infrared Technology)
- a. Manufacturers
    - 1) Hubbell WS1200AT, WattStopper WS-200 or approved equal.
  - b. General
    - 1) The passive adaptive infrared wall switch sensor shall be a self contained control system that replaces a standard toggle switch.
    - 2) Microprocessor technology shall be utilized to avoid false ON activations and to provide high sensitivity to minor occupant motion by detecting infrared energy changes within the controlled space.
    - 3) Sensor shall utilize a temperature compensated, dual element sensor and a multi-element fresnel lens.
    - 4) Sensor shall cover up to 900SF for walking motion, with a field of view of 180 degrees.
    - 5) Sensor shall have no minimum load requirement and shall be capable of controlling 800W at 100/120Vac and 1,200W at 230/277Vac electronic ballasts and incandescent loads.
    - 6) Sensor shall have a built-in adjustable light level feature that holds load off when a desired footcandle level is present.
    - 7) Sensor shall have a time delay adjustable from 5 to 30 minutes.
- C. Ceiling and Wall Mounted Sensors
1. General
    - 1) Microprocessor technology shall be utilized to avoid false ON activations and to provide high sensitivity to minor occupant motion by detecting changes in sensor readings within the controlled space.
    - 2) The sensor shall have a single pole, double throw isolated relay rated for 1.0A at 24Vdc.
    - 3) Sensor shall have a built-in adjustable light level feature that holds load off when a desired footcandle level is present.
    - 4) For accuracy and consistency, sensor shall have a controlled, digital time delay adjustable from 8 to 30 minutes.
    - 5) Provide power packs for sensors as required with the following characteristics:
      - a) For ease and speed of installation, power and auxiliary relay pack shall have 1/2" snap-in nipple for 1/2" knockouts and mounting on outside of enclosure.

- b) Power and auxiliary relay packs shall have dry contacts capable of switching 20A ballast 120/277Vac load, 13A incandescent, 1 hp at 120/240Vac
  - c) Power packs shall use 120Vac or 277Vac input and provide a 24Vdc, 100mA output.
  - d) Auxiliary relay packs shall be identical in physical size of power packs and contain no transformer power supply and shall have similar rated contacts.
  - e) Power pack can be used as a stand alone, low voltage switch, or can be wired to sensor for auto control.
  - f) Power and auxiliary relay packs shall have low voltage teflon coated leads, rated for 300V, suitable for use in plenum applications.
2. Infrared Sensor
- a. Manufacturers
    - 1) Ceiling Only Mount: Hubbell OMNI-IR-RP series, WattStopper CI series or approved equal.
    - 2) Wall Mount: Hubbell LO-DIA-RP, WattStopper CX series or approved equal.
  - b. General
    - 1) The passive infrared sensor shall be capable of detecting presence in the control area by changes in the infrared energy.
    - 2) Sensor shall utilize a temperature compensated dual element sensor and a multi-element fresnel lens.
    - 3) Sensor with a 120" mounting height shall have the following typical coverage zones:
      - a) Ceiling only mounts: 450 SF or 1,500SF areas at 360 degrees.
      - b) Wall/ceiling mounts: 1,600SF area at 110 degrees.
3. Ultrasonic Sensor
- a. Manufacturers
    - 1) Hubbell OMNI-US-RP series, WattStopper WT series or approved equal.
  - b. General
    - 1) The ultrasonic sensor shall be capable of detecting presence in the control area by doppler shifts in transmitted ultrasound within the controlled space.
    - 2) Sensors of varying frequencies shall not be allowed so as to prevent sensors from interfering with each other and to assure compatibility in the event more sensors are added.
    - 3) Sensor with a 120" mounting height shall have the following minimum rectangular coverage zones:
      - a) 500 SF at 180 degrees

b) 1,000SF or 2,000SF areas at 360 degrees.

4. Dual Technology Sensor (Infrared and Ultrasonic Technologies)

a. Manufacturers

1) Hubbell LO-DT-RP or OMNI-DT-RP series, WattStopper DT series or approved equal.

b. General

1) The passive adaptive infrared and ultrasonic sensor shall be capable of detecting presence in the control area by changes in the infrared energy and doppler shifts in transmitted ultrasound within the controlled space.

2) Sensors of varying frequencies shall not be allowed so as to prevent sensors from interfering with each other and to assure compatibility in the event more sensors are added.

3) Sensor shall utilize a temperature compensated dual element sensor and a multi-element fresnel lens.

4) Ceiling sensors with a 120" mounting height shall have the following minimum coverage zones:

a) 500 SF at 180 degrees

b) 1,000SF or 2,000SF areas at 360 degrees.

5) Wall sensor with a 120" mounting height shall have a 1,600SF minimum coverage area at nearly 180 degrees.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

A. Work shall be installed as shown on the Drawings in accordance with the manufacturer's diagrams and recommendations, except where otherwise indicated.

B. Contractor shall provide initial setup and programming for all devices and software installed under this Section for a complete and operational system. System interfaces shall be coordinated with Owner, where appropriate.

C. All cable runs shall comply with the requirements of this Division and manufacturer's specifications, and shall be continuous between devices and equipment. All control cabling shall meet CEC/NEC 725 or 800 as required and be UL listed for its application.

D. Set sensor's time delays and sensitivity adjustments in accordance to manufacturer's guidelines and Owner's direction.

E. Provide appropriate power pack for each ceiling or wall mounted occupancy sensor, whether shown or not on Drawings, unless otherwise noted.

F. Where drawings indicate slave sensors provide necessary raceway and cabling to connect sensor such that input from either master or slave sensor will activate load.

G. Locate photoelectric switches (photocell), when required, at one of the following locations with a northern or western exposure:

1. Route ½” conduit to roof and penetrate deck and locate +18” above finish floor. Seal penetration per Specifications.
  2. Route ½” conduit to nearest service or support exterior doorway and mount +8” above door frame in a flush weatherproof outlet box.
- H. Orient photocell toward north. If northern orientation cannot be obtained, orient the device west.
- I. Provide the following items for a complete and operational low voltage lighting control system as required by the manufacturer’s specifications:
1. Auxiliary cabinets and boxes for all modules and devices not mounted within relay panel.
  2. Install network modules and repeaters necessary to extend the dataline to all modules and devices within the network as required by manufacturer’s specifications.
  3. Provide ADIMs of sufficient quantities to connect all analog devices shown on Drawings.
  4. Coordinate interface with BMS/BAS with other trades and vendors to provide functionality contained herein (i.e., time clock scheduling and relay status).
  5. All low voltage cables between system components, sensors and input devices shall meet manufacturer’s specifications.
- J. Contractor shall coordinate programming of time clock schedules and relay groups not shown in Drawings with Owner.

### 3.02 *FIELD QUALITY CONTROL*

- A. The Contractor shall demonstrate the system functionality to manufacturer’s specifications and requirements after completion of installation.
- B. The Engineer or Owner may order any changes, adjustments or further tests deemed necessary to assure that the system and its components are complete and operational in accordance with the Specifications.

### 3.03 *ADJUSTING*

- A. After 60 days of Owner occupancy provide labor to adjust time delays and sensitivity adjustments on each occupancy and photocell sensor.

### 3.04 *DEMONSTRATION*

- A. The Contractor shall properly instruct the Owner to the operational procedures of the system.
- B. Within the first 30 days from system startup, the equipment supplier shall provide no less than four (4) hours for instruction and training.

**END OF SECTION**

## SECTION 26 18 11

### OVERCURRENT PROTECTION DEVICES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to overcurrent protection devices.

###### B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 REFERENCES

###### A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
  - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. Federal Specification
  - a. W-C-375; Circuit Breakers, Molded Case, Branch Circuit And Service
3. NEMA –National Electrical Manufacturer’s Association
  - a. AB 1; Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
  - b. PB 2.2; Application Guide for Ground Fault Protective Devices for Equipment
4. UL -Underwriters Laboratories, Inc.
  - a. 248; Low Voltage Fuses
  - b. 468; Wire Connectors
  - c. 508E; IEC Type "2" Coordination Short Circuit Tests
  - d. 489; Molded-Case Circuit Breakers and Circuit Breaker Enclosures
  - e. 943; Standard for Ground-Fault Circuit-Interrupters

##### 1.03 SUBMITTALS

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.
- B. Production test of circuit breakers upon request of Engineer.
- C. Submittal shall show the following information: circuit breaker numbering, circuit breaker type and short circuit rating, provisions for future circuit breakers, bussing, including neutral and ground, ratings and enclosure dimensions and trims.

#### 1.04 *QUALITY ASSURANCE*

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.
- B. The manufacturing facility shall be registered by Underwriters Laboratories Inc. to the International Organization for Standardization ISO 9002 Series Standards for quality.

#### 1.05 *DELIVERY, STORAGE AND HANDLING*

- A. Handle carefully to avoid damage to internal components, enclosure and finish.
- B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

### **PART 2 - PRODUCTS**

#### 2.01 *FUSES*

- A. All power distribution fuses shall be time-delay, high interrupting (200kAIC minimum) and current limiting type, unless otherwise indicated. All fuses shall be of same manufacturer and model.
  - 1. Motor branch circuit fuses (0 – 600A): UL Class RK5 dual element, time delay type shall be size for UL 508E "Type 2" coordination for the motor controller. Coordinate fuse selection with motor starter overload relay heaters as required.
  - 2. General purpose feeder fuses (0 – 600A): UL Class RK1 dual element, time delay type shall be size per Drawings.
- B. Control and instrumentation fuses shall of type and rating as recommended by equipment manufacturer, suitable for fuse blocks or holders installation.

#### 2.02 *MOLDED CASE CIRCUIT BREAKERS*

- A. General
  - 1. Circuit breakers shall be constructed using glass reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
  - 2. Circuit breakers shall have an over center, trip free, toggle operating mechanism which will provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.

3. The circuit breaker handle shall reside in a tripped position between ON and OFF to provide local trip indication.
  4. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker after installation.
  5. Circuit breakers shall have an RMS interrupting capacity not less than shown on Drawings, or if not shown shall not be less than:
    - a. 25kA for 480V systems
    - b. 22kA for 240V (or less) systems
  6. Each circuit breaker shall be equipped with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit breaker tripping mechanism for maintenance and testing purposes.
  7. Circuit breakers shall be equipped with UL Listed electrical accessories as noted on Drawing. Circuit breaker handle accessories shall provide provisions for locking handle in the ON and OFF position.
  8. All circuit breakers shall be UL Listed for reverse connection without restrictive line and load markings and be suitable for mounting in any position.
  9. Circuit breakers shall be constructed with factory installed mechanical lugs. All circuit breakers shall be UL Listed to accept field installable/removable mechanical type lugs. Lug body shall be bolted in place; snap in design not acceptable. All lugs shall be UL Listed to accept solid (not larger than #8 AWG) and/or stranded copper and aluminum conductors. Lugs shall be suitable for 90°C rated wire, sized according to the 75°C temperature rating in the CEC.
  10. All circuit breakers shall be capable of accepting bus connections.
- B. Thermal-Magnetic Circuit Breakers
1. Circuit breakers shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole.
  2. Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true RMS sensing and thermally responsive to protect circuit conductor(s) in a 40°C ambient temperature.
  3. Circuit breaker frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker.
  4. Provide equipment ground fault protection where shown on Drawing with the following features.
    - a. Ground fault sensing system shall be modified zero sequence sensing type and not require any external power to trip the circuit breaker.
    - b. The ground fault sensing system shall be suitable for use on grounded systems. The ground fault sensing system shall be suitable for use on three-phase, three-wire circuits where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems.



- c. Ground fault pickup current setting and time delay shall be field adjustable. A switch shall be provided for setting ground fault pickup point. A means to seal the pickup and delay adjustments shall be provided.
- d. The ground fault sensing system shall include a ground fault memory circuit to sum the time increments of intermittent arcing ground faults above the pickup point.
- e. A means of testing the ground fault system to meet the on-site testing requirements of CEC 230.95 (C) shall be provided.
- f. Local visual ground fault trip indication shall be provided.
- g. The ground fault sensing system shall be provided with Zone Selective Interlocking (ZSI) communication capabilities compatible with other thermal magnetic circuit breakers equipped with ground fault sensing, electronic trip circuit breakers with integral ground fault sensing and external ground fault sensing systems as noted on Drawings.

C. Electronic Trip Circuit Breakers

1. Circuit breaker trip system shall be a microprocessor-based true RMS sensing design with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on Drawings.
2. The integral trip system shall be independent of any external power source and shall contain no less than industrial grade electronic components.
3. The ampere rating of the circuit breaker shall be determined by the combination of an interchangeable rating plug, the sensor size and the long-time pickup adjustment on the circuit breaker. The sensor size, rating plug and adjustment positions shall be clearly marked on the face of the circuit breaker. Circuit breakers shall be UL Listed to carry 80% (or 100% where noted on Drawings) of their ampere rating continuously.
4. The following time/current response adjustments shall be provided. Each adjustment shall have discrete settings and shall be independent of all other adjustments.
  - a. Instantaneous Pickup
  - b. Long Time Pickup
  - c. Long Time Delay
  - d. Short Time Pickup
  - e. Short Time Delay
  - f. Ground Fault Pickup (when specified with ground fault protection)
  - g. Ground Fault Delay (when specified with ground fault protection)
5. A means to seal the trip unit adjustments in accordance with CEC 240.6 (B) shall be provided.
6. Local visual trip indication for overload, short circuit and ground fault trip occurrences shall be provided.

7. An ammeter to individually display all phase currents flowing through the circuit breaker shall be provided. All current values shall be displayed in true RMS with 2% accuracy.
8. Long Time Pickup indication to signal when loading approaches or exceeds the adjusted ampere rating of the circuit breaker shall be provided.
9. The trip system shall include a Long Time memory circuit to sum the time increments of intermittent overcurrent conditions above the pickup point. Means shall be provided to reset Long Time memory circuit during primary injection testing.
10. An ammeter to individually display all phase currents flowing through the circuit breaker shall be provided. Indication of inherent ground fault current flowing in the system shall be provided on circuit breakers with integral ground fault protection. All current values shall be displayed in true RMS with 2% accuracy.
11. Circuit breakers shall be equipped with back-up thermal and magnetic trip system.
12. Equipment Ground Fault Protection shall be provided where noted on Drawings.
  - a. Circuit breakers shall be provided with integral equipment ground fault protection for grounded systems. The circuit breaker shall be suitable for use on three-phase, three-wire circuits where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems.
  - b. A separate neutral current transformer shall be provided for three-phase, four-wire systems.
  - c. Ground fault sensing system shall be residual sensing type.
  - d. The trip system shall include a ground fault memory circuit to sum the time increments of intermittent ground faults above the pickup point.
  - e. A means of testing the ground fault system to meet the on-site testing requirements of CEC 230.95 (C) shall be provided.
  - f. Local visual trip indication for a ground fault trip occurrence shall be provided.
  - g. The ground fault sensing system shall be provided with Zone Selective Interlocking (ZSI) communication capabilities compatible with other thermal magnetic circuit breakers equipped with ground fault sensing, electronic trip circuit breakers with integral ground fault sensing and external ground fault sensing systems as noted on Drawings.
13. Circuit breaker trip system shall be equipped with an externally accessible test port. Disassembly of the circuit breaker shall not be required for testing. Test set shall be capable of verifying the operation of all trip functions with or without tripping the circuit breaker.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Notify Engineer no later than 10 working days for adjustable circuit breaker settings not shown within Drawings. Submit to Engineer the following information:

1. Panel, switchboard name/ID
2. Circuit breaker identifier (i.e., main circuit breaker, load served, etc.)
3. List of necessary settings (i.e., trip settings, time delays, etc.)

### 3.02 *INSTALLATION*

- A. Install equipment and their accessories in to manufacturer's instructions, pertinent Codes, and with recognized industry practices to insure device operates properly.
- B. Tighten electrical connectors and terminals in accordance to manufacturer's requirements. Where the manufacturer does not have published torque tightening values, comply with the requirements of UL 468.

### 3.03 *FIELD QUALITY CONTROL*

- A. Check tightness of circuit breaker connections using a calibrated torque wrench or torque screwdriver per manufacturer's written specifications.
- B. Contractor to obtain the services of an independent testing company who shall provide quality control and adjustments as well as tests for
  1. Check each circuit breaker above 100A on a 225A frame for long-time and short-time delay pickup and instantaneous pickup.
    - a. Instantaneous pickup current shall be determined by 4 cycles or less.
    - b. Perform timing test with 300% of breaker trip unit rated current.
    - c. Adjust unit if required, so that the tripping characteristics are within the limits of the published time-current characteristic curves for that particular trip unit.
  2. Test and calibrate ground fault protection trip and pickup time on 225A frame breakers and larger.
- C. Physically test key interlock systems to check for proper functionality.
- D. Check and set where required all protective device settings in accordance with approved coordination study settings and conduct ground fault acceptance tests.

### 3.04 *ADJUSTING*

- A. Adjust all operating mechanisms for free mechanical movement per manufacturer's specifications.
- B. Adjust circuit breaker trip and time delay settings to values indicated as instructed by Engineer.
  1. Check each circuit breaker above 100A, long-time and short-time delay pickup and instantaneous pickup. Instantaneous pickup current shall be determined by 4 cycles or less. Perform timing test with 300% of breaker trip unit rated current. Adjust unit if required, so that the tripping characteristics are within the limits of the published time-current characteristic curves for that particular trip unit.
  2. Main circuit breaker ground fault setting shall be per CEC 230.95 (A) or as directed by Engineer.

**3.05 PROTECTION**

- A. When directed by Engineer provide physical means to “permanently fix” settings for rotary and DIP type switches with a thin coat of clear lacquer.

**3.06 CLEANING**

- A. Remove marks, dirt and debris from installed equipment surfaces for “new like” appearance.

**END OF SECTION**

## SECTION 26 22 00

### LOW VOLTAGE TRANSFORMER – DRY TYPE (600VAC AND LESS)

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to transformers.

###### B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
  - a. 26 05 26 – Grounding and Bonding for Electrical Systems
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 REFERENCES

###### A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ANSI - American National Standards Institute
  - a. C57; Distribution and Power Transformers, Guide for Loading Dry-Type
2. CCR –California Code of Regulations, Title 24
  - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
3. NECA –National Electrical Contractors Association
  - a. 409; Recommended Practices for Installing and Maintaining Dry-Type Transformers
4. NEMA –National Electrical Manufacturer’s Association
  - a. ST20; Dry Type Transformers for General Applications
  - b. TP1; Guide for Determining Energy Efficiency for Distribution Transformers
  - c. TP2; Standard Test Method for Measuring the Energy Consumption of Distribution Transformers
  - d. TP3; Standard for the Labeling of Distribution Transformer Efficiency
  - e. TR1; Transformers, Regulators, and Reactors
5. UL -Underwriters Laboratories, Inc.

a. 1561; Dry-Type General Purpose and Power Transformers

**1.03 SUBMITTALS**

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.
- B. Include outline and support point dimensions of enclosures and accessories; unit weights; voltage; kVA rating; impedance rating and characteristics; loss and efficiency data at 25%, 50%, 75% and 100% rated load; sound level, tap configurations; insulation system type; and rated temperature raised

**1.04 QUALITY ASSURANCE**

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.
- B. Installation shall conform to NECA 409-2002, Recommended Practice for Installing and Maintaining Dry-Type Transformers.

**1.05 DELIVERY, STORAGE AND HANDLING**

- A. Store in a warm, dry location with uniform temperature. Protect unit if handled in inclement weather (i.e., rain, sleet, snow, etc.). Cover ventilating opening to keep out dust and foreign materials prior to startup.
- B. Handle transformer using only lifting eyes and brackets provided for that purpose; see manufacturer's installation instructions.

**PART 2 - PRODUCTS**

**2.01 GENERAL PURPOSE**

- A. Manufacturers
  - 1. Square D, Cutler-Hammer or approved equal.
- B. Rating Information
  - 1. All insulating materials are to exceed NEMA ST20 standards and be rated for 220°C UL component recognized insulation system.
  - 2. Capable of meeting daily overload requirements of ANSI C57.96.
  - 3. Transformers 15kVA and larger shall be 150°C temperature rise above 40°C ambient. Transformers 25kVA and larger shall have a minimum of 4 - 2.5% full capacity primary taps.
  - 4. The maximum temperature of the top of the enclosure shall not exceed 50°C rise above a 40°C ambient.
  - 5. Sound levels shall be warranted by the manufacturer not to exceed NEMA ST20 requirements.
- C. Construction

1. Transformer coils shall be of the continuous wound construction and shall be impregnated with nonhygroscopic, thermosetting varnish.
2. All cores to be constructed with low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point to prevent core overheating. Cores for transformers greater than 500kVA shall be clamped utilizing insulated bolts through the core laminations to ensure proper pressure throughout the length of the core. The completed core and coil shall be bolted to the base of the enclosure but isolated by means of rubber vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure except for a flexible safety ground strap. Sound isolation systems requiring the complete removal of all fastening devices will not be acceptable.
3. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable UL and CEC standards.
4. The transformer enclosures shall be ventilated and be fabricated of heavy gauge, sheet steel construction. The entire enclosure shall be finished utilizing a continuous process consisting of degreasing, cleaning and phosphatizing, followed by electrostatic deposition of polymer polyester powder coating and baking cycle to provide uniform coating of all edges and surfaces. The coating shall be UL recognized for outdoor use.
5. Manufacturer shall provide the optional accessories where required and noted on the Drawings:
  - a. Weathershields for all models.
  - b. Wall mounting brackets for 75kVA units and smaller.
  - c. Ceiling mounting brackets for 150kVA units and smaller.

## 2.02 ENERGY EFFICIENT, GENERAL PURPOSE

### A. Manufacturers

1. Square D, Cutler-Hammer or approved equal.

### B. Rating Information

1. Same as General Purpose above except:
  - a. Transformers shall be low loss type with minimum efficiencies per NEMA TP1 when operated at 35% of full load capacity. Efficiency shall be tested in accord with NEMA TP2.

### C. Construction

1. Same as General Purpose above.

## 2.03 PREMIUM GRADE

### A. Manufacturers

1. Square D, Cutler-Hammer or approved equal.

## 2.04 B. RATING INFORMATION

1. Same as General Purpose above except:
  - a. Transformers 10kVA and larger shall have the following temperature rise above 40°C ambient capable of maintaining a continuous load without exceeding a 150°C rise in a 40°C ambient:
    - 1) 115°C rise with 115% rated load.
    - 2) 80°C rise with 130% rated load.
  - b. The maximum temperature of the top of the enclosure shall not exceed 35°C rise above a 40°C ambient.

B. Construction

1. Same as General Purpose above.

2.05 *NON-LINEAR*

A. Manufacturers

1. Square D, Cutler-Hammer or approved equal.

B. Rating Information

1. Same as General Purpose above except:
  - a. Neither the primary nor the secondary temperature shall exceed 220°C at any point in the coils while carrying their full rating of non-sinusoidal load. Transformers are to be UL listed and as defined as the sum of fundamental and harmonic  $I_h(\text{pu})^2 h^2$  per UL 1561. Transformers evaluated by the UL K-Factor evaluation shall be listed for either 115°C or 80°C average temperature rise as noted on the Drawings. K-Factor listed transformers rated at 150°C rise shall not be acceptable.
  - b. K-Factor rated transformers shall have an impedance range of 3% to 5%, and shall have a minimum reactance of 2% in order to help reduce neutral current when supplying loads with large amounts of third harmonic current.

C. Construction

1. Same as General Purpose above except:
  - a. Transformers shall be supplied with quality, full width electrostatic shields resulting in a maximum effective coupling capacitance between primary and secondary of 33 picofarads. With transformers connected under normal, loaded operating conditions, the attenuation of line noise and transients shall equal or exceed the following limits:
    - 1) Common Mode: 0 to 1.5kHz - 120dB; 1.5kHz to 10kHz - 90dB; 10kHz to 100kHz - 65dB; 100kHz to 1MHz - 40dB
    - 2) Transverse Mode: 1.5kHz to 10kHz - 52dB; 10kHz to 100kHz - 30dB; 100kHz to 1MHz - 30dB

**PART 3 - EXECUTION**

3.01 *EXAMINATION*



- A. Examine transformer to provide adequate clearances for installation.
- B. Check that concrete pads are level and free of irregularities for floor mounted installations.
- C. Begin work only after unsatisfactory conditions are corrected.

### 3.02 *INSTALLATION*

- A. Read and follow manufacturer's bulletin included with unit prior to installation.
- B. Installation shall conform to NECA 409 where not specified under this Section.
- C. Transformers not specifically designed for wall mounting, shall be spaced a minimum of 6" from adjacent walls, ceiling and all other equipment.
- D. Mount to resist seismic forces and brace to 0.56g. Submit calculations and mounting details for review and approval.
- E. Terminations
  - 1. Provide all transformers with lugs for both primary and secondary conductors shown on Drawings. Connect lug to termination point with appropriate size bolt, nut and washers.
  - 2. Use flexible conduit indoors in dry locations or liquidtight flexible conduit in damp/wet locations for primary and secondary connections to transformer case when less than 48" in length. Connection shall be to enclosure's side panels only unless fed directly below from ground mounted installation or as shown on Drawings.
- F. Grounding
  - 1. Provide a dual rated four-barrel solderless grounding lug with a 5/8"-11 threaded hole. Drill transformer enclosure with 11/16" bit and attach lug to enclosure using a torque bolt and T&B Dragon Tooth transition washer with the following connections:
    - a. Primary feeder ground
    - b. Secondary feeder ground
    - c. Grounding electrode per CEC 250.30.
    - d. Main bond jumper to neutral (when present)

### 3.03 *FIELD QUALITY CONTROL*

- A. Check for damage and tight connections prior to energizing transformer.
- B. Measure primary and secondary voltages, and make appropriate tap adjustments to within 2% of rated voltage

### 3.04 *CLEANING*

- A. Touch up scratched or marred surfaces to match original finish.

## **END OF SECTION**

## **SECTION 26 24 13**

### **SWITCHBOARDS**

#### **PART 1 - GENERAL**

##### *1.01 SUMMARY*

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to switchboards and large distribution panels.

###### B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
  - a. 26 05 26 – Grounding and Bonding for Electrical Systems
  - b. 26 24 19 – Motor Control Centers
  - c. 26 18 11 – Overcurrent Protection Devices
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### *1.02 REFERENCES*

- A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
  1. ANSI - American National Standards Institute
    - a. C12.16; Solid State Electricity Metering
    - b. C57.13; Instrument Transformers
  2. CCR –California Code of Regulations, Title 24
    - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
  3. Federal Specification
    - a. W-C-37; Circuit Breakers, Molded Case, Branch Circuit and Service
  4. NECA –National Electrical Contractors Association
    - a. 400, Recommended Practice for Installing and Maintaining Switchboards
  5. NEMA –National Electrical Manufacturer’s Association
    - a. AB 1; Molded Case Circuit Breakers and Molded Case Switches
    - b. KS; Fused and Non-fused Switches

- c. PB 2; Deadfront Distribution Switchboards, File E8681
- d. PB 2.1; Proper Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less
- e. PB 2.2; Application Guide for Ground Fault Protective Devices for Equipment
- 6. UL -Underwriters Laboratories, Inc.
  - a. UL 50; Cabinets and Boxes
  - b. UL 98; Enclosed and Dead Front Switches
  - c. UL 489; Molded Case Circuit Breakers
  - d. UL 891; Dead-Front Switchboards
  - e. UL 943; Ground Fault Circuit Interrupters
  - f. UL 977; Fused Power Circuit Devices

### 1.03 SUBMITTALS

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.
- B. Shop Drawings shall indicate front and side enclosure elevations with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; one-line diagrams; equipment schedule; and switchboard instrument details.

### 1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.
- B. The manufacturing facility shall be registered by Underwriters Laboratories Inc. to the International Organization for Standardization ISO 9002 Series Standards for quality.
- C. Installation shall conform to NECA 400. Recommended Practice for Installing and Maintaining Switchboards unless otherwise specified.

### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect, and handle products in conformance with manufacturer's recommended practices as outlined in applicable Installation and Maintenance Manuals.
- B. Each switchboard section shall be delivered in individual shipping splits for ease of handling. They shall be individually wrapped for protection and mounted on shipping skids.
- C. Store in a clean, dry space. Maintain factory protection and/or provide an additional heavy canvas or heavy plastic cover to protect structure from dirt, water, construction debris, and traffic. Where applicable, provide adequate heating within enclosures to prevent condensation.

- D. Handle in accordance with NEMA PB 2.1 and manufacturer's written instructions. Lift only by lifting means provided for this express purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Tesco, Krug-Bixby-Long (KBL) Associates, or approved equal. Shall match the manufacturer for Section 26 24 19.

### **2.02 MATERIAL**

#### **A. General**

1. Utility Metering Compartment: The utility current transformer compartment shall be connected for hot sequence metering. The compartment shall comply with EUSERC and/or the local utility company specifications.
2. Switchboards shall be rated with a minimum short circuit current rating at listed voltage as shown on Drawings.
3. All unused spaces provided, unless otherwise specified, shall be fully bussed and equipped for future devices, including all appropriate connectors and mounting hardware.
4. Enclosure shall be of NEMA type shown on Drawings.
5. Sections shall be aligned front and rear.
6. The switchboard(s) shall be of deadfront construction.
7. The switchboard frame shall be of formed steel rigidly bolted together to support all cover plates, bussing and component devices during shipment and installation.
8. Each switchboard section shall have an open bottom and an individually removable top plate for installation and termination of conduit.
9. The switchboard enclosure shall be painted on all exterior surfaces. The paint finish shall be a medium gray, ANSI #49, applied by the electro-deposition process over an iron phosphate pre-treatment.
10. All front covers shall be screw removable with a single tool and all doors shall be hinged with removable hinge pins.
11. Top and bottom conduit areas shall be clearly indicated on shop drawings.
12. Provide 1" high by 3" wide engraved laminated nameplates for each device. Furnish black letters on a white background for all voltages.
13. Bus Composition shall be plated copper. Plating shall be applied continuously to all bus work. The switchboard bussing shall be of sufficient cross-sectional area to meet UL 891 temperature rise requirements. The phase and neutral through-bus shall have an ampacity as shown in the plans. For 4-wire systems, the neutral shall be of equivalent ampacity as the phase bus bar. Tapered bus is not acceptable. Full provisions for the addition of future sections shall be provided.

Bussing shall include all necessary hardware to accommodate splicing for future additions.

14. Bus Connections shall be bolted with Grade 5 bolts and conical spring washers.
  15. Ground Bus shall be sized per CEC and UL 891 Tables 25.1 and 25.2 and shall extend the entire length of the switchboard. Provisions for the addition of future sections shall be provided.
  16. Square-D I-Line or equivalent distribution bussing with the following characteristics where so noted on Drawings.
    - a. Circuit breaker(s) shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly, facilitating ease of installation of future devices.
    - b. The interior shall have three bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus., providing side-by-side mounting of breakers.
    - c. Circuit breaker(s) equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breaker(s) shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breaker(s) of different frame sizes shall be capable of being mounted across from each other.
    - d. Line-side circuit breaker connections are to be jaw type, whereby clamping forces are increased under faulted conditions.
    - e. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.
- B. Incoming main devices shall of type and accessories as shown on Drawings.
1. Circuit Breakers
    - a. Circuit breaker shall be of type, rating and poles shown on Drawings per Section 26 18 11 – Overcurrent Protection Devices.
  2. Fusible Switches
    - a. Single main group mounted through 800 A.
    - b. Fusible main switch shall be group mounted plug-on with mechanical restraint. No additional hardware shall be required to mount the fusible switch into the switchboard.
    - c. Switch shall have dual cover interlocks designed to prevent the opening of the cover when the switch is ON. The cover interlock shall prevent the switch from being turned ON with the cover open. Interlock may be manually overridden for testing purposes. Switch cover shall include a means by which the cover can be padlocked in the closed position. The operating handle shall feature positive lock-off means by providing provisions for (3) 0.375" padlocks.
    - d. Load side fusible switch connections shall be jaw type.

3. Incoming Lug Only (Distribution only, non-service entrance)
  - a. Incoming conductors shall terminate at lug landing pads rated per Drawings.
  - b. All lugs shall be UL Listed to accept solid and/or stranded copper conductors only. Lugs shall be suitable for 90°C rated wire, sized according to the 75°C temperature rating in the CEC.
  - c. Provide compression type lugs to accommodate the conductor shown on the associated drawings.
- C. Distribution section devices shall of type and accessories as shown on Drawings.
  1. Group mounted or individually mounted as shown on Drawings.
  2. All distribution circuit breakers shall be thermal-magnetic molded case, unless otherwise noted on Drawings.
  3. Circuit breaker shall be of type, rating and poles shown on Drawings per Section 26 18 11 – Overcurrent Protection Devices.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine switchboard to provide adequate clearances for installation.
- B. Check that concrete pads are level and free of irregularities.
- C. Begin work only after unsatisfactory conditions are corrected.

#### **3.02 INSTALLATION**

- A. Install switchboard in location shown on Drawings, in accordance with manufacturer's written instructions and NEMA PB 2.1. Anchor to resist seismic forces as indicated on Drawings and in accordance with California Building Code (CBC) anchorage requirements. Provide all testing and inspections requirements by inspecting authority.
- B. Installation shall conform to NECA 400 where not specified under this Section.
- C. Tighten accessible bus connection and mechanical fasteners after placing switchboard.

#### **3.03 FIELD QUALITY CONTROL**

- A. Contractor shall obtain the services of an independent testing company who shall provide quality control and adjustments as well as tests.
- B. Inspect complete installation for physical damage, proper alignment, anchorage and grounding prior to energizing.
- C. Measure the insulation resistance of each bus section phase-to-phase and phase-to-ground for one minute each at 1000Vdc; acceptable insulation resistance is 1 megaohms. Also, refer to manufacturer's specifications for specific testing procedures and values.

- D. Check tightness of accessible bolted bus joints using a calibrated torque wrench per manufacturer's specifications.
- E. Physically test key interlock systems to check for proper functionality.
- F. Test ground fault systems by push-to-test button.
- G. Check and set where required all protective device settings in accordance with approved coordination study settings and conduct ground fault acceptance tests.

#### 3.04 *ADJUSTING*

- A. Adjust all operating mechanisms for free mechanical movement per manufacturer's specifications.
- B. Tighten bolted bus connections in accordance with manufacturer's instructions.
- C. Adjust circuit breaker trip and time delay settings to values indicated by Engineer.
- D. Main circuit breaker ground fault setting shall be per CEC 230-95 (A).

#### 3.05 *CLEANING*

- A. Touch up scratched or marred surfaces to match original finish.

**END OF SECTION**

## **SECTION 26 24 16**

### **PANELBOARDS**

#### **PART 1 - GENERAL**

##### **1.01 SUMMARY**

###### **A. Section includes**

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to panelboards.

###### **B. Related sections**

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
  - a. 26 05 26 – Grounding and Bonding for Electrical Systems
  - b. 26 18 11 – Overcurrent Protection Devices
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### **1.02 REFERENCES**

###### **A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:**

1. CCR –California Code of Regulations, Title 24
  - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. Federal Specification
  - a. W-C-375; Circuit Breakers, Molded Case, Branch Circuit And Service
3. NECA –National Electrical Contractors Association
  - a. 407, Recommended Practice for Installing and Maintaining Panelboards
4. NEMA –National Electrical Manufacturer’s Association
  - a. AB 1; Molded Case Circuit Breakers
  - b. PB 1; Panelboards
  - c. PB 1.1; Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
5. UL -Underwriters Laboratories, Inc.
  - a. 50; Cabinets and Boxes
  - b. 67; Panelboards



- c. 98; Enclosed and Dead Front Switches
- d. 489; Molded-Case Circuit Breakers and Circuit Breaker Enclosures
- e. 891; Dead-Front Switchboards
- f. 943; Ground Fault Circuit Interrupters
- g. 977; Fused Power Circuit Devices<sup>50</sup>; Enclosures for Electrical Equipment

### 1.03 SUBMITTALS

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.
- B. Submittal shall show the following information: circuit breaker numbering, circuit breaker type and short circuit rating, provisions for future circuit breakers, bussing, including neutral and ground, ratings and enclosure dimensions and trims.

### 1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Handle carefully to avoid damage to internal components, enclosure and finish.
- B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Square D, Cutler-Hammer or approved equal.

### 2.02 MATERIALS

- A. Panelboards
  - 1. Interior
    - a. Shall be factory-assembled with voltage, ampacity, and short circuit rating as shown in Drawings.
    - b. Provide 1 continuous copper bus bar per phase. Each bus bar shall have sequentially phase branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current rating shall be determined by heat-rise tests conducted in accordance with UL 67. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and CEC 230.F and 230.G.
    - c. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength material.

- d. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trims shall have pre-formed twist-out covering unused mounting spaces.
  - e. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label and short circuit current rating shall be displayed on the interior.
  - f. Main and sub-feed circuit breakers shall be vertical mounted. Interior leveling provisions shall be provided for flush mounted applications.
2. Main Circuit Breaker
- a. Circuit breaker shall be of type, rating and poles shown on Drawings per Section 26 18 11 – Overcurrent Protection Devices.
3. Branch Circuit Breakers
- a. Circuit breakers shall be of type, rating and poles shown on Drawings per Section 26 18 11 – Overcurrent Protection Devices.
4. Enclosures
- a. Type NEMA 1 Boxes
    - 1) Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Galvanealed steel will not be acceptable.
    - 2) Boxes shall have removable endwalls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
    - 3) Box width shall be 20 in wide.
  - b. Type NEMA 1 Fronts
    - 1) Front shall meet strength and rigidity requirements per UL 50 standards. Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
    - 2) Fronts shall be hinged 1-piece with door. Mounting shall be as indicated in Drawings.
    - 3) Panelboards rated 225 amperes and below shall flat fronts with concealed door hinges and trim screws. Front shall not be removable with the door locked. Panelboards rated above 225 amperes shall have fronts with trim clamps and concealed door hinges. Front doors shall have rounded corners and edges shall be free of burrs.
    - 4) Front shall have cylindrical tumbler type lock with catch and spring-loaded stainless steel door pull. All lock assemblies shall be keyed alike. Two (2) keys shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.
  - c. Type NEMA 3R, 5, and 12

- 1) Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
- 2) All doors shall be gasketed and equipped with a tumbler type vault lock. All lock assemblies shall be keyed alike. 2 keys shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.
- 3) Maximum enclosure dimensions shall not exceed 20 in wide and 6.5 in deep.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's written instructions and NEMA PB 1.1.
- B. Installation shall conform to NECA 407 where not specified under this Section.
- C. Anchor panelboards to structural members and as shown on Drawings. Provide additional support as required. Anchor freestanding distribution panels to concrete pad.
- D. Mount panelboards level and plumb.
- E. Install flush mounted panel backbox front edges flush with finished wall. Where flush panel backbox is deeper than wall depth, install closing trim of wood or metal to provide a finished trim.
- F. Where panelboard is flush in wall, provide one  $\frac{3}{4}$ " conduit stub into accessible ceiling above for every 5 spare circuit breaker or available space.
- G. After installation, make all feeder connections to circuit breaker load side lugs and incoming secondary feeders.

#### **3.02 FIELD QUALITY CONTROL**

- A. Inspect complete installation prior to energizing for physical damage, proper alignment, anchorage and grounding.
- B. Check tightness of bolted connections and circuit breaker connections using a calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

#### **3.03 ADJUSTING**

- A. Measure steady state load line currents at each panelboard feeder; rearrange panelboard circuits to balance the phase loads with 20% of each other. Maintain proper phasing for multi-wire branch circuits.
- B. Fill out panelboard circuit identification card, typewritten, with list of circuits in use. Identification shall be specific with room designation and other information as necessary. For distribution panels, use engraved laminated phenolic plates showing load served.

**END OF SECTION**

## SECTION 26 24 19

### MOTOR CONTROL CENTERS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to motor control centers (MCC).

###### B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
  - a. 40 50 00 – Instrumentation and Controls – General Provisions
  - b. 40 50 01– I&C - Control Panels and Panel Mounted Equipment
  - c. 26 05 26 – Grounding and Bonding for Electrical Systems
  - d. 26 29 23 – Variable Frequency Drives
  - e. 26 18 11 – Overcurrent Protection Devices
  - f. 26 24 16 – Panelboards
  - g. 26 22 00 – Low Voltage Transformer - Dry-Type
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 REFERENCES

- ###### A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
1. CCR –California Code of Regulations, Title 24
    - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
  2. Federal Specification
    - a. W-C-37; Circuit Breakers, Molded Case, Branch Circuit And Service
  3. NECA –National Electrical Contractors Association
    - a. 402, Recommended Practice for Installing and Maintaining Motor Control Centers
  4. NEMA –National Electrical Manufacturer’s Association

- a. AB 1; Molded Case Circuit Breakers and Molded Case Switches
  - b. ICS 1; Industrial Control and Systems: General Requirements
  - c. ICS 2; Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts
  - d. KS; Fused and Non-fused Switches
5. UL -Underwriters Laboratories, Inc.
- a. UL 489; Molded Case Circuit Breakers
  - b. UL 845; Motor Control Centers

### 1.03 SUBMITTALS

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.
- B. Shop Drawings shall indicate front and side enclosure elevations with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; one-line diagrams; equipment schedule; and switchboard instrument details.

### 1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.
- B. The manufacturing facility shall be registered by Underwriters Laboratories Inc. to the International Organization for Standardization ISO 9001 Series Standards for quality.
- C. The manufacturer of the MCC shall also be the manufacturer of the across the line motor starters, solid state reduced voltage starters and variable frequency drives. The use of third party supply and assembly is not acceptable and will be rejected.
- D. Installation shall conform to NECA 402, Recommended Practice for Installing and Maintaining Motor Control Centers unless otherwise specified.

### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect, and handle products in conformance with manufacturer's recommended practices as outlined in applicable Installation and Maintenance Manuals.
- B. Each switchboard section shall be delivered in individual shipping splits for ease of handling. They shall be individually wrapped for protection and mounted on shipping skids.
- C. Store in a clean, dry space. Maintain factory protection and/or provide an additional heavy canvas or heavy plastic cover to protect structure from dirt, water, construction debris, and traffic. Where applicable, provide adequate heating within enclosures to prevent condensation.

- D. Handle in accordance with manufacturer's written instructions. Lift only by lifting means provided for this express purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Rockwell Automation Allen-Bradley or approved equal.

### **2.02 RATINGS**

- A. Voltage - Unless shown differently on the drawings, the MCC shall be rated for a 480V system.
- B. Short Circuit Withstand Rating – Unless shown differently on the drawings, the MCC shall be rated for a fault current of 42,000A.

### **2.03 ENCLOSURE**

- A. The MCC shall be NEMA Type 1 Gasketed unless otherwise indicated in the Drawings.
- B. Removable end plates on each end of the MCC shall cover the horizontal bus and horizontal wireway openings.
- C. The MCC shall include bottom plates.
- D. Each section shall be equipped with full metal side sheets to isolate each vertical section.
- E. All interior and exterior surfaces shall be painted ANSI 49 medium light gray. The vertical wireways and unit back plates shall be painted high visibility gloss white.
- F. All unpainted parts shall be plated for corrosion resistance.

### **2.04 STRUCTURE**

- A. Motor control centers (MCC) shall be made up of standardized, freestanding modular sections.
- B. The MCC shall be of dead front construction and shall consist of one or more vertical sections bolted together to form a rigid, free-standing assembly. The systems shall be designed to allow for the addition of future sections and to permit the interchanging of units. The overall length of the MCC shall not exceed the dimensions shown on the Drawings.
- C. All louvers and vents shall be screened and supplied with replaceable filters.
- D. Vertical sections shall be rigid, free-standing structures.
  - 1. Vertical sections shall have internal mounting angles running continuously within the shipping block.
  - 2. Vertical sections shall be 90 inches high, 20 inches deep and 20 inches wide except where larger dimensions are required.

3. Vertical sections shall be provided with a removable steel lifting angle on all shipping blocks. The angle shall run the length of the shipping block.
- E. Provide full depth horizontal wireways at the top and bottom of the MCC.
1. The horizontal wireways shall be isolated from the bus.
  2. The horizontal wireways shall have removable covers held in place by captive screws.
- F. Provide a full height vertical wireway, independent of the plug-in units, in each standard vertical section.
1. The vertical wireway shall be isolated from the vertical and horizontal buses.
  2. The vertical wireway shall be covered with a hinged and secured door.
  3. Wireway tie bars shall be provided.
  4. Isolation between the wireway and units shall be provided.
- G. Unit Information
1. Each vertical section shall accommodate six size No. 1 combination starter spaces or “buckets” within each vertical section. Only one-half of full multiples of this unit space shall be used for the various types and sizes of equipment in the MCC. Starters and other equipment shall be arranged on the front only.
  2. Construction shall be NEMA Class II to provide complete systems wiring and individual combination motor starter units shall be Type B with unit mounted terminal blocks.
  3. NEMA Size 5 starters and below shall be provided as plug-in units.
  4. Plug-in units
    - a. Plug-in units shall consist of unit assembly, unit support pan and unit door assembly.
    - b. Units shall be supplied with removable doors. The unit doors shall be fastened to the structure so that the doors can be closed when the unit is removed.
    - c. A unit support pan shall be provided for support and guiding units. Unit support pans shall remain in the structure when units are removed to provide isolation between units.
    - d. A service position shall be provided for plug-in units that allows for the unit to be supported, but disengaged from the bus. The unit shall be capable of being padlocked in the service position.
  5. Power Stabs
    - a. Unit stabs for engaging the power bus shall be tin plated copper and provided with stainless back-up springs to provide and maintain a high pressure 4-point connection to the vertical bus.
    - b. Wiring from the unit disconnecting means to the plug-in stabs shall not be exposed to the rear of the unit. A separate isolated pathway shall be provided

for each phase to minimize the possibility of unit fault conditions reaching the power bus system.

- c. The power cable termination at the plug-in stab shall be a maintenance free crimp type.
6. Handle
    - a. Units shall be provided with a heavy-duty, industrial, flange mounted handle mechanism for control of each disconnect switch or circuit breaker.
    - b. The operator units may pivot in the vertical or horizontal plane.
    - c. The on-off condition shall be indicated by the handle position, red and green color indicators with the words ON and OFF, and the international symbols I and O along with a pictorial indication of the handle position.
    - d. Handles shall be capable of being locked in the OFF position with up to three padlocks.
    - e. The operator handle shall be interlocked with the unit door so that the disconnect cannot be switched to the ON position unless the unit door is closed. A means shall be provided for purposely defeating the interlock during maintenance or testing.
    - f. The operator handle shall be interlocked with the unit so that the unit cannot be inserted or withdrawn with the operator handle in the ON position.
  7. Pilot Devices
    - a. Where specified, units shall be furnished with NEMA Type 4/13 water tight / oil tight pushbuttons, selector switches or pilot lights.
  8. Terminal Blocks
    - a. Control terminal blocks shall be pull-apart on all plug-in units for easy removal of the unit from the structure.
    - b. Control terminal blocks on factory mounted units shall be fixed type.
    - c. Provide power terminal blocks on starters rated NEMA size 3 and below. Power terminal blocks shall be pull-apart for NEMA size 1 and 2. Terminal blocks for NEMA size 3 starters shall be non-pull apart. Power terminal blocks are not required on NEMA size 4 and above.
    - d. Terminal blocks shall not be located adjacent to or inside the vertical wireway.

## 2.05 BUS BARS

### A. Horizontal Power Bus

1. The horizontal bus shall be rated as shown on the drawings.
2. The horizontal bus material shall be copper with tin plating.
3. The horizontal bus shall be supported, braced and isolated from the vertical bus with a high strength, non-tracking glass polyester material.



4. For standard sections the horizontal bus shall be continuous within each shipping block and shall be braced within each section
5. Horizontal bus splices shall have at least 2 bolts on each side.

B. Vertical Bus

1. The vertical power bus shall have an effective rating of 600A. If a center horizontal bus construction is utilized, then the rating shall be 300A above and below the horizontal bus for an effective rating of 600A. If a top or bottom mounted horizontal bus is utilized, then the full bus must be rated for 600A.
2. The vertical bus material shall be copper with tin plating.
3. The vertical bus shall attach to the horizontal bus with at least 2 bolts.
4. The vertical bus shall be continuously braced by a high strength non-tracking glass-filled polyester material and sandwiched by a glass-filled polycarbonate molded cover.
5. Automatic shutters shall cover plug-in stab openings when units are removed.

C. Ground Bus

1. Provide a ground bus system consisting of a horizontal ground bus connected to vertical ground buses mounted in each section.
2. Provide an unplated copper (0.25 inch by 2 inch) horizontal ground bus mounted in the bottom of the MCC unless otherwise specified in the drawings.
3. Provide a pressure type mechanical lug mounted on the ground bus in the incoming line section.
4. Provide a unit ground stab on all unit inserts. The ground stab shall establish unit insert grounding to the vertical ground bus before the plug-in power stabs engage the power bus. The grounding shall be maintained until after the plug-in power stabs are disengaged.
5. Provide an unplated copper vertical unit load ground bus in each standard vertical section.
6. Provide a unit load connector on all units. The load connector shall provide a termination point for the load ground cable at the unit.

D. Neutral Bus

1. If a 4-wire system is specified, yet there are no neutral loads in the MCC, only a neutral connection plate is required in the MCC; i.e. a full neutral bus is not required.
2. If neutral loads are specified within the MCC, a full neutral bus is required. Provide a neutral bus across the full width of the MCC, an incoming neutral lug pad in the incoming section, and neutral connection plates in sections as required.

2.06 DISCONNECTS

- A. The withstand rating of the main shall be greater than or equal to the bus bracing for the MCC.

- B. Provide lugs to accommodate the conductors as indicated on the drawings.
- C. If no overcurrent protection is indicated, provide a main incoming lug compartment.
- D. Fusible disconnect assemblies where specified in Drawings shall comply with Section 26 28 11 – Overcurrent Protection Devices.
- E. Circuit breaker disconnect assemblies specified in Drawings shall comply with Section 26 28 11 – Overcurrent Protection Devices.
- F. Provide a removable protective barrier to reduce the possibility of contact with the line terminals.
- G. Provide one normally open and one normally closed internal auxiliary contact on disconnect device.

#### **2.07 COMBINATION NEMA RATED ACROSS THE LINE STARTERS**

- A. Starters shall be of NEMA design. Starters shall have molded coils, replaceable contacts and metal housing plate. NEMA rated / IEC designed starters will be rejected.
- B. Starters shall be provided with a 3-pole Class 20 solid state overloads unless noted otherwise. The overload shall provide overload and phase loss protection.
- C. Starters shall be provided with a minimum of (1) N.O. and (1) N.C. auxiliary contact in addition to the hold in contact and auxiliary contacts shown on the drawings up to a maximum of seven beyond the hold-in contact.
- D. Provide a control power transformer with a VA rating of at least twice the sealed VA rating of the starter. Provide both primary and secondary fuse protection for the starter.
- E. Provide a door mounted selector switch for Hand-Off-Auto operation. The Hand Mode shall provide local start control. In the Auto Mode, start control shall be provided through a remote contact. Provide an extra set of contacts on the selector switch for monitoring of switch position.
- F. Provide door mounted transformer type pilot lights for On (Green) and Off (Red) indication.

#### **2.08 SOLID STATE MOTOR CONTROLLERS (SSMC)**

- A. The unit shall be provided with overcurrent protection and disconnect device as shown on Drawing.
- B. The unit shall be provided with a 120V control power transformer. The control power transformer shall be provided with primary and secondary fusing.
- C. The SSMC unit shall be provided with a bypass contactor for NEMA 12 designs. The bypass contactor shall be energized once the motor is up to full speed. The bypass contactor shall be fully rated for the motor load and be capable of starting the motor if so wired in the field. The unit shall be provided with a converter module so that the SSMC overload can be utilized at all times.
- D. Provide an input isolation contactor.

- E. The SSMC unit shall be provided with line side protective modules. The modules shall contain capacitors and metal oxide varistors (MOVs) that protect the internal power circuitry from severe electrical transients and / or high electrical noise.
- F. Provide a door mounted selector switch for Auto-Manual control. In the auto mode, the start command shall be provided through a remote contact. In the manual mode, the start-stop control shall be provided through the door mounted push buttons. Provide extra contact blocks on the selector switch for monitoring of switch position.
- G. Provide door mounted pushbuttons for start-stop and pump stop control. Stop pushbuttons shall always be active.
- H. Provide door mounted transformer type pilot lights for indication of On (Green) and Off (Red).

#### 2.09 VARIABLE FREQUENCY DRIVES

- A. The unit shall be provided with overcurrent protection and disconnect device as shown on Drawing.
- B. The unit shall be provided with a 120V control power transformer. The control power transformer shall be provided with primary and secondary fusing.
- C. Provide a 120V control interface.
- D. Provide a common mode choke on the output of the drive.
- E. Provide a door mounted selector switch for Auto-Manual control. In the auto mode, the start command shall be provided through a remote contact. In the manual mode, the start-stop control shall be provided through the door mounted push buttons. Provide extra contact blocks on the selector switch for monitoring of switch position.
- F. Provide door mounted pushbuttons for start-stop control. Stop pushbuttons shall always be active.
- G. Provide door mounted transformer type pilot lights for indication of On (Green) and Off (Red).
- H. Provide a door mounted Human Interface for programming, display and speed control.
- I. Provide one isolated / configurable analog input and output.

#### 2.10 CONTROL AND LIGHTING TRANSFORMER

- A. Provide control and lighting transformers as shown on drawings. The rating shown on the drawings shall be the minimum acceptable rating.
- B. The insulation shall be Class 180°C insulation with 80°C rise.
- C. Provide thermal magnetic circuit breaker for primary protection.
- D. The primary circuit breaker compartment and transformer compartment shall be wired and interlocked together.
- E. Provide secondary fuse protection for the transformer.
- F. Provide vented doors with filters for NEMA Type 1 with gaskets and NEMA Type 12 structures.

### 2.11 LIGHTING PANEL

- A. Provide distribution panel as shown on the Drawings and per Section 26 24 16 – Panelboards.

## **PART 3 - EXECUTION**

### 3.01 EXAMINATION

- A. Examine motor control center to provide adequate clearances for installation.
- B. Check that concrete pads are level and free of irregularities.
- C. Begin work only after unsatisfactory conditions are corrected.

### 3.02 INSTALLATION

- A. Install motor control center in location shown on Drawings, in accordance with manufacturer's written instructions. Anchor to resist seismic forces as indicated on Drawings and in accordance with OSHPD's anchorage requirements. Provide all testing and inspections requirements by inspecting authority.
- B. Installation shall conform to NECA 402 where not specified under this Division.
- C. Tighten accessible bus connection and mechanical fasteners after placing motor control center.

### 3.03 FIELD QUALITY CONTROL

- A. Inspect complete installation for physical damage, proper alignment, anchorage and grounding prior to energizing.
- B. Check tightness of accessible bolted bus joints using a calibrated torque wrench per manufacturer's specifications.
- C. Check and set where required all protective device settings in accordance with approved coordination study settings and conduct ground fault acceptance tests.

### 3.04 ADJUSTING

- A. Adjust all operating mechanisms for free mechanical movement per manufacturer's specifications.
- B. Tighten bolted bus connections in accordance with manufacturer's instructions.
- C. Adjust circuit breaker trip and time delay settings to values indicated as instructed by Engineer.

### 3.05 CLEANING

- A. Touch up scratched or marred surfaces to match original finish

**END OF SECTION**

## **SECTION 26 27 26**

### **WIRING DEVICES**

#### **PART 1 - GENERAL**

##### **1.01 SUMMARY**

###### **A. Section includes**

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to wiring devices.

###### **B. Related sections**

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
  - a. 26 05 26 – Grounding and Bonding for Electrical Systems
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### **1.02 REFERENCES**

###### **A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:**

1. Federal Specification
  - a. W-C-596; Connector, Electrical, Power, General Specification for
  - b. W-S-896; Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification)
2. NEMA –National Electrical Manufacturer’s Association
  - a. WD 1; General Color Requirements for Wiring Devices
  - b. WD 6; Wiring Devices-Dimensional Requirements
3. UL -Underwriters Laboratories, Inc.
  - a. 20; General-Use Snap Switches
  - b. 498; Standard for Attachment Plugs and Receptacles
  - c. 943; Standard for Ground-Fault Circuit-Interrupters
  - d. 1449; Standard for Transient Voltage Surge Suppressors

##### **1.03 SUBMITTALS**

- ###### **A. Submit manufacturer’s data for materials specified within this Section in accordance to Section 26 05 00.**

#### 1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

### **PART 2 - PRODUCTS**

#### 2.01 SWITCHES

##### A. Wall switches

1. Specification grade, quiet, AC rated, mechanical, snap type with silver alloy contacts, and shall comply with NEMA WD-1 and Fed. Spec W-S-896.
2. Rating shall be 20A at 120/277Vac, unless otherwise shown.
3. Handles shall be nylon; color shall be compatible with adjacent wall finish.
4. Manufacturers and types
  - a. Single pole, single throw
    - 1) Cooper Wiring Devices #CSB120, Hubbell #CSB120, or equal.
  - b. Double pole, single throw
    - 1) Cooper Wiring Devices #CSB220, Hubbell #CSB220, or equal.
  - c. Three way
    - 1) Cooper Wiring Devices #CSB320, Hubbell #CSB320, or equal.

#### 2.02 RECEPTACLES

##### A. Standards

1. Specification grade, NEMA 5-15R configuration grounding type, rated 15A at 125/250Vac that conform to NEMA WD-6 and Fed. Spec W-C-596.
2. At dedicated receptacle locations and as otherwise noted, use specification grade, NEMA 5-20R configuration grounding type, rated 20A at 125/250Vac that conform to NEMA WD-6 and when possible Fed. Spec W-C-596.
3. Specialty receptacles shall conform to NEMA WD-6 and UL standards as applicable.

##### B. Color

1. General purpose receptacle face shall be nylon; color shall be compatible with adjacent wall finish, unless otherwise indicated.

##### C. Receptacle types

1. General purpose single
  - a. Provide self-grounding back and side wired with binding head staked terminal screw.
  - b. Use Cooper Wiring Devices #5261, Hubbell #5261, or equal for NEMA 5-15R.

- c. Use Cooper Wiring Devices #5361, Hubbell #5361, or equal for NEMA 5-20R.
2. General purpose duplex
  - a. Provide self-grounding back and side wired with binding head staked terminal screws and break-off strip for two circuit wiring.
  - b. Use Cooper Wiring Devices #5262, Hubbell #5262, or equal for NEMA 5-15R.
  - c. Use Cooper Wiring Devices #5362, Hubbell #5362, or equal for NEMA 5-20R.
3. Transient voltage surge suppressor (TVSS) duplex
  - a. Provide 20A, 125Vac receptacle consisting of NEMA 5-20R duplex device with integral TVSS protection circuit.
  - b. Provide LED indicator to verify surge protection and ground, and audible alarm to notify bad ground connection or surge protection expiration.
  - c. TVSS characteristics:
    - 1) 400V clamping voltage.
    - 2) 280J energy rating.
    - 3) 150Vac RMS MOV rating
    - 4) 18kA maximum surge current in all modes (L-N, L-G and N-G)
  - d. Use Cooper Wiring Devices #5362\_S, no known equal.
4. Isolated ground
  - a. Provide receptacle specified within this Section with equipment grounding contacts connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap.
5. Ground fault circuit interrupter (GFCI) duplex
  - a. Provide 20A, 125Vac receptacle consisting of NEMA 5-20R duplex device with integral solid state sensing and signaling circuitry capable of detecting and interrupting a maximum 5mA line-to-ground fault current in approximately 1/40th of a second per UL 943.
  - b. Provide visual device with trip indication, manual reset and test mechanisms per UL 943.
  - c. Device shall be capable of point of use and multi-outlet protection.
  - d. Use Cooper Wiring Devices #XGF20, Hubbell #GF53, or equal.
6. Hospital grade and tamper resistant
  - a. Provide receptacle specified within this Section that conforms to UL 498 “Hospital Grade” requirements.
  - b. Tamper resistance receptacle shall have integral protection mechanism to prevent accidental shock from foreign object contacting energized blades.
7. Special purpose

- a. Provide specification grade devices with NEMA configuration, voltage, ampacity, poles and ground provisions as noted on Drawings.

### 2.03 *WALL PLATES*

- A. Interior locations
  1. Finished Areas: 0.032" stainless steel, brushed or satin finish with required number of openings for location.
  2. Exposed Areas: galvanized, raised type.
- B. Exterior: die-cast copper-free aluminum, gasketed, raintight cover UL listed for exterior and wet locations while in use. Use Hubbell #WP8M (duplex), #WP26M (GFCI) or equal.
- C. Screws shall match plate.
- D. Tamper resistance receptacles shall have exposed screws of tamper resistant type.
- E. Individual, gangable wall plates are not acceptable where two or more devices are installed at one location.

## **PART 3 - EXECUTION**

### 3.01 *PREPARATION*

- A. Coordinate device heights with drawings and details.
- B. Locate switches on latch side of door, unless otherwise indicated.

### 3.02 *INSTALLATION*

- A. Mount and align device and wall plates level and plumb. Insure wall plates fit flat against wall and tight against device without strain on plate.
- B. Comply with manufacturer's instructions regarding termination of conductors to wiring device.
- C. Provide wall plates for all outlet boxes with devices.
- D. Install blank wall plates on all outlet boxes in which no device is present or installed.

**END OF SECTION**



## SECTION 26 28 16

### SAFETY SWITCHES AND INDIVIDUAL MOUNTED CIRCUIT BREAKERS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to heavy duty fusible, non-fusible and double throw safety switches.

###### B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
  - a. 26 05 26 – Grounding and Bonding for Electrical Systems
  - b. 26 18 11 – Overcurrent Protection Devices
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 REFERENCES

###### A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
  - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. NEMA –National Electrical Manufacturer’s Association
  - a. KS 1; Enclosed Switches
  - b. 250; Enclosures for Electrical Equipment
3. UL -Underwriters Laboratories, Inc.
  - a. 98; Enclosed and Dead Front Switches
  - b. 489; Molded-Case Circuit Breakers and Circuit Breaker Enclosures

##### 1.03 SUBMITTALS

- ###### A. Submit manufacturer’s data for materials specified within this Section in accordance to Section 26 05 00.

##### 1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

#### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Handle carefully to avoid damage to internal components, enclosure and finish.
- B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

### **PART 2 - PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Square D, Cutler Hammer or approved equal.

#### 2.02 MATERIALS

- A. Heavy-duty safety switches
  1. Switch interior
    - a. All switches shall have switch blades which are visible when the switch is OFF and the cover is open.
    - b. Lugs shall be front removable and UL Listed for 75°C conductors, aluminum or copper.
    - c. 30A through 100A switches shall be equipped with factory or field installed fuse pullers.
    - d. Switches required for Type 12, 12K or Type 4-4X-5 stainless steel applications shall have all copper current carrying parts.
    - e. All current carrying parts shall be plated to resist corrosion.
    - f. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.
    - g. Switches shall have provisions for a field installable electrical interlock.
  2. Switch mechanism
    - a. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
    - b. The operating handle shall be an integral part of the box, not the cover.
    - c. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.
    - d. The handle position shall travel at least 90° between OFF and ON positions to clearly distinguish and indicate handle.
    - e. All switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock

mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

3. Switch enclosures

- a. All enclosures shall be NEMA 1 general purpose unless otherwise noted.
- b. Switch covers shall be attached:
  - 1) with welded pin-type hinges (Type 1, 12, 12K, 4-4X-5 stainless steel).
  - 2) top hinged, attached with removable screws and securable in the open position (Type 3R).
  - 3) by molded hinges and type 316 stainless steel hinge pins (Type 4X polyester).
  - 4) by type 316 stainless steel bolts (Type 7/9).
- c. The enclosure shall be finished with:
  - 1) gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel (Type 1).
  - 2) gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated galvanized steel (Type 3R, 12, 12K).
  - 3) a brush finish on type 304 stainless steel (Type 4-4X-5 stainless steel).
  - 4) Gray baked enamel on copper free cast aluminum alloy (Type 7/9).
- d. The enclosure shall have ON and OFF markings:
  - 1) stamped into the cover (Type 1, 3R, 4-4X-5 stainless steel, 12, 12K).
  - 2) cast into the cover (Type 7/9).
  - 3) inked on a adhesive label (Type 4X polyester).
- e. The operating handle shall be provided with a dual colored, red/black position indication.
- f. All switches shall have provisions to accept up to three 3/8" hasp padlocks to lock the operating handle in the OFF position.

4. Switch ratings

- a. Switches shall be horsepower rated for ac and/or dc as indicated on Drawings.
- b. The UL Listed short circuit current rating of the switches shall be:
  - 1) 10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600A).
  - 2) 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600A switches employing appropriate fuse rejection schemes).
  - 3) 200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200A)

B. Double throw switches

1. Shall have the same characteristics as heavy-duty safety switches above for switch interior, mechanism, enclosure and rating.
2. Additional switch operating mechanism characteristics shall be:
  - a. quick-make, quick-break for 60A through 200A, 2 pole and 3 pole devices.
  - b. Slow-make, slow-break for
    - 1) 30A and greater than 200A, 2 pole and 3 pole devices.
    - 2) 60A through 200A, 4 pole devices.

C. Individual Mounted Circuit Breakers

1. Circuit Breaker
  - a. Circuit breakers shall be of type, rating and poles shown on Drawings per Section 26 18 11 – Overcurrent Protection Devices.
2. Enclosure
  - a. Enclosure shall be galvanized steel constructed in accordance with UL 50 requirements, and be NEMA 1, unless specifically shown or specified otherwise.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

- A. The equipment shall be installed per the manufacturer's recommendations.
- B. Anchor safety switches to structural members and as shown on Drawings. Provide additional support as required.
- C. Mount safety switches level and plumb.

**3.02 FIELD QUALITY CONTROL**

- A. Inspect complete installation prior to energizing for physical damage, proper alignment, anchorage and grounding.
- B. Check tightness of bolted connections per manufacturer's written specifications.

**END OF SECTION**

## **SECTION 26 32 13**

### **ENGINE GENERATOR**

#### **PART 1 - GENERAL**

##### *1.01 SUMMARY*

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to engine generators, its accessories and controls.

###### B. Related work under this section

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
  - a. 26 05 26 – Grounding and Bonding for Electrical Systems
  - b. 26 18 11 – Overcurrent Protection Devices
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### *1.02 REFERENCES*

###### A. The generator set and its installation and on-site testing shall conform to the requirements of the following codes and standards:

1. CCR –California Code of Regulations, Title 24
  - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
  - b. Part 9 -California Fire Code; WFCU Uniform Fire Code (UFC) with California amendments
2. FCC Part 15, Subpart B.
3. ISO –International Organization for Standardization
  - a. 8528; Reciprocating Internal Combustion Engine Driven Alternating Current Generating Sets (All Parts)
4. IEEE –Institute of Electrical and Electronic Engineers
  - a. C2; National Electrical Safety Code (NESC)
  - b. 446; Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications
5. NECA –National Electrical Contractors Association
  - a. 404; Recommended Practice for Installing Generator Sets

6. NEMA –National Electrical Manufacturer’s Association
  - a. ICS 1; Industrial Control and Systems: General Requirements
  - b. MG 1; Motors and Generators
  - c. MG 2; Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators
7. NFPA –National Fire Protection Association
  - a. 37; Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
  - b. 99; Standard for Health Care Facilities
  - c. 110; Standard for Emergency and Standby Power Systems
8. UL -Underwriters Laboratories, Inc.
  - a. 508; Standard for Industrial Control Equipment
  - b. 2085; Standard for Protected Aboveground Tanks for Flammable and Combustible Liquids
  - c. 2200; Standard for Stationary Engine Generator Assemblies

#### 1.03 *SYSTEM DESCRIPTION*

- A. Provide a standby power system to supply electrical power at 277/480Volts,60 Hertz, 3 Phase, 4 Wire. The generator shall consist of a liquid cooled diesel engine, a synchronous AC alternator, and system controls with all necessary accessories for a complete operating system, including but not limited to the items as specified hereinafter.
- B. The stand-by generator set shall be supplied to operate on No. 2 diesel fuel. The engine shall be liquid cooled by means of engine mounted radiator.
- C. The stand-by generator set shall be rated continuous stand-by (defined continuous for the duration of any power outage) per Part 2 below.
- D. Engine: The turbo charged engine shall be diesel fueled, 4 cycle, liquid cooled, with a governed speed of 1800 RPM. Engine shall be turbocharged with intercooler/aftercooler, forged steel crankshaft and rods. Engine shall be equipped with 90% efficient controls for crankcase emissions, in full conformance with the latest and applicable California Air Resources requirements and all local emissions requirements. Submit certifications with the submittals.

#### 1.04 *SUBMITTALS*

- A. Submit manufacturer’s data for materials specified within this Section in accordance to Section 26 05 00.
- B. The submittal shall contain the following minimum information:
  1. Engine Generator specification sheet
  2. Controls specification sheet(s)
  3. Installation / Layout dimensional drawing

4. Wiring schematic
  5. Sound data
  6. Emission certification
  7. Warranty statement
- C. Manufacturer shall assist Owner in acquiring all necessary CARB installation and initial operation permits for the gen-set.

**1.05 QUALITY ASSURANCE**

- A. Installation shall conform to NECA 404, Recommended Practice for Installing Generator Sets unless otherwise specified.
- B. The engine shall be equipped with all devices and accessories required to meet the California Air Resources Board and other applicable State and Local emissions standards.

**1.06 DELIVERY, STORAGE AND HANDLING**

- A. Handle carefully to avoid damage to internal components, enclosure and finish.
- B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

**1.07 WARRANTY**

- A. Furnish one-year guarantee in accordance with and in form required under Section 26 05 00.
- B. The generator set and associated equipment shall be warranted for a period of not less than 5 years from the date of commissioning against defects in materials and workmanship.
- C. Service and support
  1. The manufacturer of the generator set shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.
  2. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.
  3. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

**1.08 SYSTEM STARTUP**

- A. Refer to manufacturer's documentation to start-up procedures and requirements.

**PART 2 - PRODUCTS**

## 2.01 MANUFACTURER

- A. All equipment shall be new and of current production of a National firm, who manufactures the generator, engine, control panel, acoustical assemblies comprising the stand-by generator set as a matched unit, having a service and parts organization.
- B. Manufacturer: Cummins, Caterpillar, or approved equal.
- C. General
  - 1. Basis of design is Cummins.
  - 2. Ratings based on site conditions of : Altitude 215 ft. ambient temperatures up to 122°F
  - 3. The generator set rating shall be based on emergency/standby service.
- D. Genset at Domestic Water Plant “EG-1” (CANTUA CREEK)
  - 1. Cummins DQDAA Sound Level 2 Housing
    - a. The generator set shall operate at 1800 RPM and at a voltage of: 277/480Vac, 3 phase, Four-wire, 60 Hz.
    - b. The generator set shall be stand-by rated at 250kW, 313kVA, 377A at 0.8 PF.
    - c. The alternator shall support 220kVA (locked rotor) with a maximum voltage dip of 10%.
- E. Genset at Well #4 Site “EG-1” (EL PORVENIR)
  - 1. Cummins DQDAA Sound Level 2 Housing
    - a. The generator set shall operate at 1800 RPM and at a voltage of: 277/480Vac, 3 phase, Four-wire, 60 Hz.
    - b. The generator set shall be stand-by rated at 250kW, 313kVA, 377A at 0.8 PF.
    - c. The alternator shall support 220kVA (locked rotor) with a maximum voltage dip of 10%.

## 2.02 ENGINE

- A. Engine Rating and Performance
  - 1. The prime mover shall be a liquid cooled, diesel fueled, turbocharged after-cooled engine of 4-cycle design. It will have adequate horsepower to achieve rated kW output with at an operating speed of 1800 RPM.
  - 2. The engine shall support a 100% load step.
  - 3. The generator system shall support generator start-up and load transfer within 10 seconds.
- B. Engine Oil System
  - 1. Full pressure lubrication shall be supplied by a positive displacement lube oil pump. The engine shall have a replaceable oil filter(s) with internal bypass and replaceable element(s).



2. The engine shall operate on mineral based oil. Synthetic oils shall not be required.
3. The oil shall be cooled by an oil cooler which is integrated into the engine system.

C. Engine Cooling System

1. The engine is to be cooled with a unit mounted radiator, fan, water pump, and closed coolant recovery system. The coolant system shall include a coolant fill box which will provide visual means to determine if the system has adequate coolant level. The radiator shall be designed for operation in 122 degrees F, (50 degrees C) ambient temperature.
2. The engine shall have (a) unit mounted, thermostatically controlled water jacket heater(s) to aid in quick starting. The wattage shall be as recommended by the manufacturer.
3. Engine coolant and oil drain extensions, equipped with pipe plugs and shut-off valves, must be provided to the outside of the mounting base for cleaner and more convenient engine servicing.
4. A radiator fan guard must be installed for personnel safety that meets UL and OSHA safety requirements.

D. Engine Starting System

1. Starting shall be by a solenoid shift, DC starting system.
2. The engine's cranking batteries shall be lead acid. The batteries shall be sized per the manufacturer's recommendations. The batteries supplied shall meet NFPA 110 cranking requirements of 90 seconds of total crank time. Battery specifications (type, amp-hour rating, cold cranking amps) to be provided in the submittal.
3. The genset shall have an engine driven, battery charging alternator with integrated voltage regulation.
4. The genset shall have an automatic dual rate, float equalize, 10 amp battery charger. The charger must be protected against a reverse polarity connection. The chargers charging current shall be monitored within the generator controller to support remote monitoring and diagnostics. The battery charger is to be factory installed on the generator set. Due to line voltage drop concerns, a battery charger mounted in the transfer switch will be unacceptable.

E. Engine Fuel System

1. The engine fuel system shall be designed for operation on #2 diesel fuel and cold weather diesel blends.
2. The engine shall include a primary fuel filter, water separator, manual fuel priming pump, and engine flexible fuel lines must be installed at the point of manufacture. Element shall be replaceable paper type.
3. The engines suction line shall be fitted with a check valve to secure prime for the engines injection pump.

F. Engine Controls

1. Engines that are equipped with an electronic engine control module (ECM), shall monitor and control engine functionality and seamlessly integrate with the genset controller through digital communications. ECM monitored parameters shall be integrated into the genset controllers NFPA 110 alarm and warning requirements. All ECM fault codes shall be displayed at the genset controller in standard language - fault code numbers are not acceptable.
2. For engines without ECM functionality or for any additional genset controller monitoring, sensors are to be conditioned to a 4-20ma signal level to enhance noise immunity and all sensor connections shall be sealed to prevent corrosion.
3. Engine speed shall be controlled with an integrated isochronous governor function with no change in alternator frequency from no load to full load. Steady state regulation is to be 0.25%.

G. Engine Exhaust & Intake

1. The engine exhaust emissions shall meet the EPA emission requirements for standby power generation.
2. The manufacturer shall supply its recommended stainless steel, flexible connector to couple the engine exhaust manifold to the exhaust system. A rain cap will terminate the exhaust pipe after the silencer. All components must be properly sized to assure operation without excessive back pressure when installed.
3. The manufacturer shall supply a critical grade exhaust silencer as standard. For applications with site specific sound requirements (reference section 1.1), the silencer shall be selected to achieve site sound levels.
4. For gensets in a weather or sound attenuated enclosure, all exhaust piping from the turbo-charger discharge to the silencer shall be thermally wrapped to minimize heat dissipation inside the enclosure.
5. The engine intake air is to be filtered with engine mounted, replaceable, dry element filters.

2.03 ALTERNATOR

- A. The alternator shall be the voltage and phase configuration as specified in this Section.
- B. The alternator shall be a 4 pole, revolving field, stationary armature, synchronous machine. The excitation system shall utilize a brushless exciter with a three phase full wave rectifier assembly protected against abnormal transient conditions by a surge protector. Photo-sensitive components will not be permitted in the rotating exciter.
- C. The alternator shall include a permanent magnet generator (PMG) for excitation support. The system shall supply a minimum short circuit support current of 300% of the rating (250% for 50Hz operation) for 10 seconds.
- D. Three phase alternators shall be 12 lead, broad range capable of supporting voltage reconnection. Single phase alternators shall be four lead and dedicated voltage designs (600v) shall be six lead. All leads must be extended into a NEMA 1

connection box for easy termination. A fully rated, isolated neutral connection must be included by the generator set manufacturer.

- E. The alternator shall use a single, sealed bearing design. The rotor shall be connected to the engine flywheel using flexible drive disks. The stator shall be direct connected to the engine to ensure permanent alignment.
- F. The alternator shall meet temperature rise standards of UL2200 (120 degrees C). The insulation system material shall be class "H" capable of withstanding 125 degrees C temperature rise.
- G. The alternator shall be protected against overloads and short circuit conditions by advanced control panel protective functions. The control panel is to provide a time current algorithm that protects the alternator against short circuits. To ensure precision protection and repeatable trip characteristics, these functions must be implemented electronically in the generator control panel -- thermal magnetic breaker implementation are not acceptable.
- H. An alternator strip heater shall be installed to prevent moisture condensation from forming on the alternator windings. A tropical coating shall also be applied to the alternator windings to provide additional protection against the entrance of moisture.

#### 2.04 CONTROLS

- A. The generator control system shall be a fully integrated microprocessor based control system for standby emergency engine generators meeting all requirements of NFPA 110 level 1.
- B. The generator control system shall be a fully integrated control system enabling remote diagnostics and easy building management integration of all generator functions. The generator controller shall provide integrated and digital control over all generator functions including: engine protection, alternator protection, speed governing, voltage regulation and all related generator operations. The generator controller must also provide seamless digital integration with the engine's electronic engine control module (ECM) if so equipped. Generator controller's that utilize separate voltage regulators and speed governors or do not provide seamless integration with the engine management system are considered less desirable.
- C. Communications shall be supported with building automation via the Modbus protocol without network cards. Optional internet and intranet connectivity shall be available.
- D. The control system shall provide an environmentally sealed design including encapsulated circuit boards and sealed automotive style plugs for all sensors and circuit board connections. The use of non-encapsulated boards, edge cards, and pc ribbon cable connections are considered unacceptable.
- E. Circuit boards shall utilize surface mount technology to provide vibration durability. Circuit boards that utilize large capacitors or heat sinks must utilize encapsulation methods to securely support these components.
- F. A predictive maintenance algorithm that alarms when maintenance is required. The controller shall have the capability to call out to the local servicing dealer when maintenance is required.

- G. Diagnostic capabilities should include time-stamped event and alarm logs, ability to capture operational parameters during events, simultaneous monitoring of all input or output parameters, callout capabilities, support for multi-channel digital strip chart functionality and .2 msec data logging capabilities.
- H. In addition to standard NFPA 110 alarms, the application loads should also be protected through instantaneous and steady state protective settings on system voltage, frequency, and power levels.
- I. The control system shall provide pre-wired customer use I/O: 4 relay outputs (user definable functions), communications support via RS232, RS485, or an optional modem. Additional I/O must be an available option.
- J. Customer I/O shall be software configurable providing full access to all alarm, event, data logging, and shutdown functionality. In addition, custom ladder logic functionality inside the generator controller shall be supported to provide application support flexibility. The ladder logic function shall have access to all the controller inputs and customer assignable outputs.
- K. The control panel will display all user pertinent unit parameters including: engine and alternator operating conditions; oil pressure and optional oil temperature; coolant temperature and level alarm; fuel level (where applicable); engine speed; DC battery voltage; run time hours; generator voltages, amps, frequency, kilowatts, and power factor; alarm status and current alarm(s) condition per NFPA 110 level 1.

#### 2.05 ENGINE / ALTERNATOR PACKAGING

- A. The engine/alternator shall be isolated from the generator frame with rubber isolators. The packaging shall not require the addition of external spring isolators.
- B. A mainline, thermal magnetic circuit breaker carrying the UL mark shall be factory installed. The breaker shall be rated between 100 to 125% of the rated ampacity of the genset. The line side connections are to be made at the factory. Output lugs shall be provided for load side connections.
- C. A second mainline, thermal magnetic circuit breaker carrying the UL mark shall be factory installed. The line side connections are to be made at the factory. Output lugs shall be provided for load side connections.
- D. The generator shall include a unit mounted 120 volt convenience outlet.
- E. Enclosure
  1. The genset shall be packaged with a sound attenuating enclosure with a maximum rating of 78dBA at any location 23 feet from the generator set in a free field environment.
  2. The enclosure shall be completely lined with sound deadening material. This material must be of a self-extinguishing design.
  3. The enclosure shall be made of steel with a minimum thickness of 14 gauge. The enclosure is to have hinged, removable doors to allow access to the engine, alternator and control panel. The hinges shall allow for door fit adjustment. Hinges and all exposed fasteners will be stainless steel or JS5000. The use of pop-rivets weakens the paint system and not allowed on external painted

surfaces. Key-locking and pad-lockable door latches shall be provided for all doors.

4. The enclosure shall be coated with electrostatic applied powder paint, baked and finished to manufacturer's specifications. The color will be manufacturer's standard.
5. The enclosure shall utilize an upward discharging radiator hood. Due to concerns relative to radiator damage, circulating exhaust, and prevailing winds, equipment without a radiator discharge hood will not be acceptable.
6. The genset silencer shall be mounted on the discharge hood of the enclosure. Due to architectural concerns, silencers mounted on the top of the generator enclosure are not acceptable. Gensets with silencers mounted inside the main generator compartment are acceptable only if the silencer is thermally wrapped to minimize heat stress on the surrounding components.

F. Base:

1. The engine-generator set shall be mounted with vibration isolators Caldyn or equal, on a heavy duty steel base to maintain proper alignment between components. The engine-generator set shall incorporate a battery tray with battery hold-down clamps within the base rails.

G. Sub-base fuel tank

1. The packaging shall include a double wall, sub-base mounted, UL142 listed fuel tank. The tank shall be sized to provide 24 hours of run time.
2. The tank shall include fuel suction and return connections, normal and emergency vents, secondary containment emergency vent and rupture basin sensor, mechanical fuel level indication and a stub-up area convenient for electrical conduit entry.
3. The fuel tank shall use an electric fuel sensor to provide an analog indication of fuel level. The controller shall have a warning indication on low fuel level and provide optional shutdown functionality for low, low fuel level.
4. The fuel tank shall have a sloped top and bottom. The sloped top allows water to run off. The sloped bottom allows the water and other impurities in the fuel to collect near the back of the tank away from the fuel suction point.
5. The fuel tank must be supplied by the engine-generator set manufacturer and be installed before shipment.

## 2.06 LOOSE ITEMS

A. Supplier to itemize loose parts that require site mounting and installation. Preference will be shown for gensets that factory mount items like mufflers, battery chargers, etc.

B. Spare Parts:

1. Fuses: One spare set
2. Filters One spare set (air, fuel, oil)

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Equipment shall be installed by the contractor in accordance with final submittals and Drawings. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
- B. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier. Provide flexible electrical connections from pad to equipment.
- C. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.
- D. Equipment shall be initially started and operated by representatives of the manufacturer.
- E. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

### **3.02 STARTUP AND COMMISSIONING**

- A. The supplier of the electric generating plant and associated items covered herein shall provide factory trained technicians to checkout the completed installation and to perform an initial startup inspection to include:
  - 1. Ensuring the engine starts (both hot and cold) within the specified time.
  - 2. Verification of engine parameters within specification.
  - 3. Verify no load frequency and voltage, adjusting if required.
  - 4. Test all automatic shutdowns of the engine-generator.
  - 5. Perform a load test of the electric plant, ensuring full load frequency and voltage are within specification by using building load.
- B. Provide documentation of the above tests in accordance to NFPA 110.

### **3.03 TESTING**

- A. The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests.
- B. Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two hour full load test, and a one step rated load pickup test in accordance with

- NFPA 110. Provide a resistive load bank and make temporary connections for full load test.
- C. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.
  - D. After installation, the Contractor shall demonstrate to the Owner and the Local Fire Authority that the fuel system is complete, without leaks and is seismically braced.

#### *3.04 TRAINING*

- A. Training is to be supplied by the start-up technician during commissioning. The training should cover basic generator operation and common generator issues that can be managed by the end-user.
- B. Training is to include manual operation of system.

**END OF SECTION**

## SECTION 26 36 00

### AUTOMATIC TRANSFER & BYPASS-ISOLATION SWITCH

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to automatic transfer switches (ATS) or automatic transfer switch with by-pass switch (ATS/BPS).

###### B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
  - a. 26 05 26 – Grounding and Bonding for Electrical Systems
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 REFERENCES

###### A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
  - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. NEMA –National Electrical Manufacturer’s Association
  - a. ICS10-1993 (formerly ICS2-447) -AC Automatic Transfer Switches
3. NFPA –Nation Fire Protection Association
  - a. NFPA 99 -Essential Electrical Systems for Health Care Facilities
  - b. NFPA 110 -Emergency and Standby Power Systems
4. UL -Underwriters Laboratories, Inc.
  - a. UL 508 Industrial Control Equipment
  - b. UL 1008 -Standard for Transfer Switch Equipment

##### 1.03 SUBMITTALS

- ###### A. Submit manufacturer’s data for materials specified within this Section in accordance to Section 26 05 00.



- B. Shop Drawings shall indicate front and side enclosure elevations with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; one-line diagrams; equipment schedule; and instrument details.

#### **1.04 QUALITY ASSURANCE**

- A. The complete assembly shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
- B. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
- C. The manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation, and servicing in accordance with ISO 9001.

#### **1.05 DELIVERY, STORAGE AND HANDLING**

- A. Deliver, store, protect, and handle products in conformance with manufacturer's recommended practices as outlined in applicable Installation and Maintenance Manuals.
- B. Store in a clean, dry space. Maintain factory protection and/or provide an additional heavy canvas or heavy plastic cover to protect structure from dirt, water, construction debris, and traffic. Where applicable, provide adequate heating within enclosures to prevent condensation.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Emerson Power/ASCO Series 7000 or approved equal.

#### **2.02 EQUIPMENT**

- A. Mechanically Held Transfer Switch
  1. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.
  2. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
  3. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.

4. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.
  5. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.
  6. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfers between two active power sources are not acceptable.
  7. Where neutral conductors must be switched as shown on the plans, the AS shall be provided with fully rated overlapping neutral transfer contacts. The neutrals of the normal and emergency power sources shall be connected together only during the transfer and retransfer operation and remain connected together until power source contacts close on the source to which the transfer is being made. The overlapping neutral contacts shall not overlap for a period greater than 100 milliseconds. Neutral switching contacts that do not overlap are not acceptable.
  8. Where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.
- B. Bypass-Isolation Switch (only as noted on Drawings)
1. A two-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.
  2. Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the bypass-isolation switch. All control interwiring shall be provided with disconnect plugs.
  3. Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door. Designs requiring insertion of loose operating handles or opening of the enclosure door to operate are not acceptable.
  4. Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts). Designs that disconnect the load when bypassing are not acceptable. The bypass handle shall have three operating modes: "Bypass to Normal," "Automatic," and "Bypass to Emergency." The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the manual handle is operated. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.
  5. The isolation handle shall provide three operating modes: "Closed," "Test," and "Open." The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switches with no interruption of power to

the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.

6. When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.
7. Designs requiring operation of key interlocks for bypass isolation or ATS's that cannot be completely withdrawn when isolated are not acceptable.

#### C. Microprocessor Controller

1. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.
2. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to  $\pm 1\%$  of nominal voltage. Frequency sensing shall be accurate to  $\pm 0.2\%$ . The panel shall be capable of operating over a temperature range of -20 to +60°C and storage from -55 to +85°C.
3. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manuals.
4. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.
5. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
  - a. IEEE472 (ANSI C37.90A) Ring Wave Test.
  - b. EN55011 1991 Class A Conducted and Radiated Emission.
  - c. EN61000-4-2 Electrostatic Discharge Immunity, Direct Contact & Air Discharge.
  - d. EN61000-4-3 Radiated Electromagnetic Field Immunity.
  - e. EN61000-4-4 Electrical Fast Transient Immunity.
  - f. EN61000-4-5 Surge Immunity.
  - g. ENV50141 HF Conducted Disturbances Immunity.

#### D. Enclosure

1. The ATS/BPS shall be furnished in a NEMA type 1 enclosure unless otherwise shown on the plans.

2. All standard and optional door-mounted switches and pilot lights shall be 16mm industrial grade type or equivalent for easy viewing & replacement. Door controls shall be provided on a separate removable plate, which can be supplied loose for open type units.

## 2.03 OPERATION

### A. Controller Display and Keypad

1. A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:
  - a. Nominal line voltage and frequency
  - b. Single or three phase sensing
  - c. Operating parameter protection
  - d. Transfer operating mode configuration: (Open transition, Closed transition or Delayed transition)
2. All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

### B. Voltage, Frequency and Phase Rotation Sensing

1. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout and trip setting capabilities (values shown as % of nominal unless otherwise specified):

Parameter	Sources	(Dropout/Trip)	(Pickup/ Reset)
Undervoltage	N&E,3 $\phi$	70 to 98%	85 to 100%
Overvoltage	N&E,3 $\phi$	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Unbalance	N&E	5 to 20%	1% below dropout

2. Repetitive accuracy of all settings shall be within  $\pm 0.5\%$  over an operating temperature range of  $-20^{\circ}\text{C}$  to  $60^{\circ}\text{C}$ .
3. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.
4. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).
5. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

### C. Time Delays

1. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.
2. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
3. Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
4. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
5. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes:
  - a. Prior to transfer only.
  - b. Prior to and after transfer.
  - c. Normal to emergency only.
  - d. Emergency to normal only.
  - e. Normal to emergency and emergency to normal.
  - f. All transfer conditions or only when both sources are available.
6. The controller shall also include the following built-in time delays for optional Closed Transition and Delayed Transition operation:
  - a. 1 to 5 minute time delay on failure to synchronize normal and emergency sources prior to closed transition transfer.
  - b. 0.1 to 9.99 seconds time delay on an extended parallel condition of both power sources during closed transition operation.
  - c. 0 to 5 minute time delay for the load disconnect position for delayed transition operation.
7. All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in .01 second increments.
8. All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port.

### D. Additional Features

1. A three position momentary-type test switch shall be provided for the test / automatic / reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.

2. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.
3. LED indicating lights (16mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
4. LED indicating lights (16mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.
5. Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
6. Terminals shall be provided for a remote contact that opens to signal the ATS to transfer to emergency and for remote contacts that open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.
7. An inphase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS manufacturer. The inphase monitor shall be equal to ASCO Feature 27.
8. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.
9. System Status -The controller LCD display shall include a “System Status” screen which shall be readily accessible from any point in the menu by depressing the “ESC” key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. Controllers that require multiple screens to determine system status or display “coded” system status messages, which must be explained by references in the operator’s manual, are not permissible.
10. Self-Diagnostics -The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status-input signals to the controller that may be preventing load transfer commands from being completed.
11. Communications Interface –The controller shall be capable of interfacing, through an optional serial communication module, with a network of transfer switches, locally (up to 4000 ft.) or remotely through modem serial communications. Standard software specific for transfer switch applications shall be available by the transfer switch manufacturer. This software shall allow for the monitoring, control and setup of parameters.
12. Data Logging –The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:

- a. Event Logging
    - 1) Data and time and reason for transfer normal to emergency.
    - 2) Data and time and reason for transfer emergency to normal.
    - 3) Data and time and reason for engine start.
    - 4) Data and time engine stopped.
    - 5) Data and time emergency source available.
    - 6) Data and time emergency source not available.
  - b. Statistical Data
    - 1) Total number of transfers.
    - 2) Total number of transfers due to source failure.
    - 3) Total number of days controller is energized.
    - 4) Total number of hours both normal and emergency sources is available.
13. Communications Module -A full duplex RS485 interface shall be installed in the ATS controller to enable serial communications. The serial communications shall be capable of a direct connect or multi-drop configured network. This module shall allow for the seamless integration of existing or new communication transfer devices. The serial communication interface shall be equal to ASCO Accessory 72.

#### 2.04 WITHSTAND AND CLOSING RATINGS

- A. The ATS/BPS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS/BPS terminals with the type of overcurrent protection shown on the plans.
- B. The ATS/BPS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATS/BPS's which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.

#### 2.05 POWER MANAGER

- A. Furnish Power Managers to monitor all functions specified below for all ATS/BPS.
- B. The Power Managers shall be listed to UL 3111-1, CSA, CE Mark, and industrially rated for an operating temperature range of -20 C to 60 C.
- C. The Power Manager shall be accurate to 1% measured, 2% computed values and display resolution to .1%. Voltage and current for all phases shall be sampled simultaneously to assure high accuracy in conditions of low power factor or large waveform distortions (harmonics).
- D. The Power Manager shall be capable of operating without modification at nominal frequencies of 45 to 66 Hz and over a control power input range of 20 - 32VDC.
- E. Each Power Manager shall be capable of interfacing with an optional communications module to permit information to be sent to central location for display, analysis, and logging.

- F. The Power Manager shall accept inputs from industry standard instrument transformers (120 VAC secondary PTs and 5A secondary CTs.) Direct phase voltage connections, 600 VAC and under, shall be possible without the use of PTs.
- G. The Power Manager shall be applied in single, 3-phase, or three & four wire circuits. A fourth CT input shall be available to measure neutral or ground current.
- H. All setup parameters required by the Power Manager shall be stored in non-volatile memory and retained in the event of a control power interruption.
- I. The following metered readings shall be communicated by the Power Manager, via serial communication, when equipped with optional serial communications module:
  - 1. Current, per phase RMS and neutral (if applicable)
  - 2. Current Unbalance %
  - 3. Voltage, phase-to-phase and phase-to-neutral
  - 4. Voltage Unbalance %
  - 5. Real power (KW), per phase and 3-phase total
  - 6. Apparent power (KVA), per phase and 3-phase total
  - 7. Reactive power (KVAR), per phase and 3-phase total
  - 8. Power factor, 3-phase total & per phase
  - 9. Frequency
  - 10. Accumulated Energy, (MWH, MVAH, and MVARH)
- J. The following energy readings shall be communicated by the Power Manager:
  - 1. Accumulated real energy KWH
  - 2. Accumulated reactive energy KVAH
  - 3. Accumulated apparent energy KVARH
- K. Power Manager Input/Output Options.
  - 1. Power Managers shall be equipped with the following I/O:
    - a. Provide (8) solid state status inputs.
    - b. Provide four (4) relay output contacts

### **PART 3 – EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine ATS to provide adequate clearances for installation.
- B. Check that concrete pads (floor mounted models) and walls (wall mounted models) are level and free of irregularities.
- C. Begin work only after unsatisfactory conditions are corrected.

#### **3.02 INSTALLATION**

- A. Install switchboard in location shown on Drawings, in accordance with manufacturer's written instructions. Anchor to resist seismic forces as indicated on



Drawings and in accordance with California Building Code anchorage requirements. Provide all testing and inspections requirements by inspecting authority.

- B. Tighten accessible bus connection and mechanical fasteners after placing switchboard.

### 3.03 *FIELD QUALITY CONTROL*

- A. Inspect complete installation for physical damage, proper alignment, anchorage and grounding prior to energizing.
- B. Manufacturers' field services
  - 1. The ATS/BPS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
  - 2. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

### 3.04 *CLEANING*

- A. Touch up scratched or marred surfaces to match original finish

**END OF SECTION**

## SECTION 26 43 13

### TRANSIENT VOLTAGE SURGE SUPPRESSORS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to transient voltage surge suppressors (TVSS).

###### B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
  - a. 26 05 26 – Grounding and Bonding for Electrical Systems
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.02 REFERENCES

###### A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ANSI - American National Standards Institute
  - a. C62.11; Metal-Oxide Surge Arresters for Alternating Current Power Circuits
  - b. C62.33; Standard Test Specifications for Varistor Surge-Protective Devices
  - c. C62.41; Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
  - d. C62.45; Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits
2. CCR –California Code of Regulations, Title 24
  - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
3. IEEE –Institute of Electrical and Electronic Engineers
  - a. 446; Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications
  - b. 1100; Recommended Practices Powering and Grounding Electronic Equipment
4. Military Specification
  - a. MIL-STD-220; Test Method Standard, Method of Insertion Loss Measurement

5. NEMA –National Electrical Manufacturer’s Association
  - a. LS1; Low Voltage Surge Protection Devices
6. UL -Underwriters Laboratories, Inc.
  - a. 50; Standard for Enclosures for Electrical Equipment
  - b. 67; Standard for Panelboards
  - c. 845; Standard for Motor Control Centers
  - d. 857; Busways
  - e. 1283; Standard for Electromagnetic Interference Filters
  - f. 1449; Standard for Transient Voltage Surge Suppressors

### **1.03 SYSTEM DESCRIPTION**

- A. The TVSS shall be a parallel design transient voltage surge suppression system integrated into panelboards and distribution panels. The system shall utilize diversion modules to suppress and divert transient voltage and surge currents. The system shall be design to provide protection for sensitive electronic devices against the effects of surges, transients and electrical line noises.

### **1.04 SUBMITTALS**

- A. Submit manufacturer’s data for materials specified within this Section in accordance to Section 26 05 00.

### **1.05 QUALITY ASSURANCE**

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

### **1.06 DELIVERY, STORAGE AND HANDLING**

- A. Handle carefully to avoid damage to internal components, enclosure and finish.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURER**

- A. APT, Current Technology, Cutler-Hammer or approved equal.

### **2.02 GENERAL**

- A. Electrical Requirements
  1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
  2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall be greater than 115% of the nominal system operating voltage.

3. The suppression system shall incorporate a hybrid designed Metal-Oxide Varistors (MOV) surge suppressor for the service entrance and other distribution level. The system shall not utilize silicon avalanche diodes, selenium cell, air gaps or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – For a wye configured system, the device must have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a delta-configured system, the device must have suppression elements between line to line (L-L) and line to ground (L-G).
5. UL 1449 2nd Edition Suppressed Voltage Rating (SVR) – The maximum UL 1449 2nd Edition SVR for the device must not exceed the following:
  - a. Voltage: L-N; L-G; N-G & L-L modes
  - b. 208Y/120: 400V & 800V
  - c. 480Y/277: 800V & 1800V
  - d. 600Y/347: 1200V & 1800V
6. – The let through voltage based on IEEE C62.41 and C62.45 recommended procedures for Category C3 surges (20 kV, 10 kA) shall be less than:
  - a. Voltage: L-N
  - b. 208Y/120: 560V
  - c. 480Y/277: 960V
  - d. 600Y/347: 1840V
7. ANSI/IEEE Cat. B3 Let Through Voltage – Let through voltage based on IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. B3 ringwave (6 kV, 500 amps) shall be less than:
  - a. Voltage: L-N
  - b. 208Y/120: 160V
  - c. 480Y/277: 165V
  - d. 600Y/347: 168V

**B. TVSS Design**

1. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating TVSS modules shall not be acceptable.
2. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 50 dB at 100 kHz using the MIL-STD-220A insertion loss test method. Products not able to demonstrate noise attenuation of 50 dB @ 100 kHz shall be rejected.
3. Extended Range Filter –The Surge Protective Device shall have a High Frequency Extended Range Tracking Filter in each Line to Neutral mode with compliance to UL 1283 and NEMA LS1. The filter shall have published high frequency attenuation rating in the attenuation frequencies.

- a. Attenuation Frequency - Insertion Loss (ratio) - Insertion Loss ( dB)
  - b. 50kHz -40 -32
  - c. 100kHz -316 -50
  - d. 500kHz -318 -50
  - e. 1MHz -89 -39
  - f. 10MHz -200 -46
  - g. 100MHz -79 -38
4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.
  5. Standard Monitoring Diagnostics – Each TVSS shall provide integral monitoring options:
    - a. Each unit shall provide a green / red solid state indicator light shall be provided on each phase. The absence of a green light and the presence of a red light, shall indicate which phase(s) have been damaged.
    - b. Remote Status Monitor – The TVSS device must include form C dry contacts (one NO and one NC) for remote annunciation of unit status. The remote alarm shall change state if any of the three phases detect a fault condition.
    - c. Audible Alarm – The TVSS shall provide an audible alarm with a reset pushbutton that will be activated under any fault condition.
    - d. Event Counter – The TVSS shall be equipped with an LCD display system designed to indicate to the user how many surges, sags, swells and outages have occurred at the location. The event-counter triggers each time under each respective category after significant event occurs. A reset pushbutton shall also be standard allowing all counters to be zeroed.
    - e. Push to Test – The TVSS shall be equipped with push-to-test feature, designed to provide users with real time testing of the suppressor's monitoring and diagnostic system. By depressing the test button, the diagnostic system initiates a self test procedure. If the system is fully operational, the self test will activate all indicator lights.
    - f. Voltage Monitoring – The TVSS shall display true Root Mean Square (RMS) on three L-N voltage protection mode on Wye configuration and three L-L voltage on delta configuration.
  6. Overcurrent Protection Fusing: In order to isolate the TVSS under any fault condition , the manufacturer shall provide:
    - a. Individual Fusing: MOV's shall be individually fused via Copper Fuse Trace. The Copper Fuse shall allow protection during high surge (kA) events.
    - b. Thermal Protection: MOV's shall be equipped with Thermal Fuse Spring (TFS) technology which allows disconnection of the suppression component at the overheated stage common during temporary over voltage condition. For small fault currents between 100mA to 30Amp, or if the occurrence is

over a longer period of time, the TFS will disconnect first. Manufacturers that utilize fuse trace only shall not be approved since there is no fault current protection between 100mA to 30A.

- c. All overcurrent protection components shall be tested in compliance with UL 1449-Limited Current Test and AIC rating test.
- C. Minimum Repetitive Surge Current Capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 1992
1. The suppression filter system shall be repetitive surge tested in every mode utilizing a 1.2 x 50µsec, 20kV open circuit voltage. 8 x 20µsec, 10kA short circuit current Category C3 bi-wave at one minute intervals without suffering either performance degradation or more than 10% deviation of clamping voltage at a specified surge current. The minimum repetitive surge current capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 1992 shall be:
    - a. Service Entrance: 12000 impulse per mode.
    - b. Distribution Panelboard: 10000 impulse per mode.
    - c. Branch Location Panelboard: 9000 impulse per mode.

### 2.03 SYSTEM APPLICATION

- A. The TVSS applications covered under this section include distribution and branch panel locations, bus plugs, motor control centers (MCC), switchgear, and switchboard assemblies. The branch panel located TVSS shall be tested and demonstrate to be suitable for ANSI/IEEE C62.41 Category C1 environments.
1. Surge Current Capacity - The minimum total surge current 8 x 20 microsecond waveform that the device is capable of withstanding in compliance to ANSI/IEEE C62.41 AND NEMA LS1
    - a. Application -Service Entrance Locations (Switchboards Switchgear, MCC Main Entrance)
      - 1) 250kA Per Phase
      - 2) 125kA Per Mode
      - 3) 12,000 Surge Withstand Capabilities ANSI/IEEE C3 Wave (10kA)
    2. Application -High Exposure Roof Top Locations (Distribution Panelboards)
      - 1) 160kA Per Phase
      - 2) 80kA Per Mode
      - 3) 9,000 Surge Withstand Capabilities ANSI/IEEE C3 Wave (10kA)
    3. Application -Branch Locations (Panelboards, MCCs, Busway)
      - 1) 120kA Per Phase
      - 2) 60kA Per Mode
      - 3) 5,000 Surge Withstand Capabilities ANSI/IEEE C3 Wave (10kA)
- B. Lighting and Distribution Panelboard Requirements

1. The TVSS application covered under this section includes lighting and distribution panelboards. The TVSS units shall be tested to demonstrate suitability for ANSI/IEEE C62.41 Category C1 environments.
  2. The TVSS shall not limit the use of Through-feed lugs, Sub-feed lugs and Sub-feed breaker options.
  3. The TVSS shall be immediately installed on the load side of the main breaker.
  4. The panelboard shall be capable of re-energizing upon removal of the TVSS.
  5. A direct bus bar connection shall be used to mount the TVSS component to the panelboard bus bar to reduce the impedance of the shunt path.
  6. The TVSS panelboard shall be constructed using a direct bus bar connection (cable connection between bus bar and TVSS device is not acceptable). TVSS units that use a cable connection do not meet the intent of this specification.
  7. The TVSS shall be included and mounted within the panelboard by the manufacturer of the panelboard.
  8. The complete panelboard including the TVSS shall be UL67 listed.
- C. Retrofit Installation (externally mounted suppressor). Maximum conductor lead length between breaker and suppressor shall not exceed 14 inches. Comply with the manufacturer's recommended installation and wiring practices.
- D. Switchgear, Switchboard, MCC and Busway/ Bus Plug Requirements
1. The TVSS application covered under this section is for switchgear, switchboard, MCC and Bus Plug locations. Service entrance located TVSS shall be tested and suitable for ANSI/IEEE C62.41 Category C3 environments.
  2. The TVSS shall be factory installed inside the switchgear, switchboard, MCC and Bus Plug at the assembly point by the original equipment manufacturer.
  3. Locate suppressor on load side of main disconnect device, as close as possible to the phase conductors and ground/neutral bar.
  4. Provide a 30-amp disconnect. The disconnect shall be directly integrated to the suppressor and assembly bus using bolted bus bar connections.
  5. The TVSS shall be integral to switchgear, switchboard, MCC and Bus Plug as factory standardized design.
  6. All monitoring diagnostics features shall be visible from the front of the equipment.

#### **2.04 ENCLOSURES**

- A. All enclosed equipment shall have NEMA 1/3R general purpose enclosures, unless otherwise noted.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.

B. Provide TVSS protection for electrical equipment where indicated on Drawings.

C. External and Retrofit TVSS Applications

1. Conductors from the power source to TVSS shall be #4 AWG copper with absolute maximum length of 84" in Service Entrance Locations (Switchboards, Switchgear, MCC Main Entrance) & #8 AWG copper with absolute maximum length of 12" in all other applications.
2. Conductors shall be routed without sharp bends and straight and short as possible.
3. External cabinets shall be anchored and braced to withstand seismic forces.

### 3.02 *FIELD QUALITY CONTROL*

- A. Prior to energizing TVSS inspect for physical damage, defects, alignment and fit; verify nameplate information with application and Drawings; and check tightness of all control and power connections.

**END OF SECTION**



## **SECTION 26 50 00**

### **LIGHTING**

#### **PART 1 - GENERAL**

##### **1.01 SUMMARY**

###### **A. Section includes**

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to fixtures, lamps, standards, bases, hangers, supports, reflectors, glassware, lenses, auxiliary equipment, ballasts and sockets.

###### **B. Related work under this section**

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### **1.02 REFERENCES**

###### **A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:**

1. ANSI -American National Standards Institute
  - a. C78; American National Standard for Electric Lamps
  - b. C81; American National Standard for Electric Lampholders
  - c. C82; American National Standard for Lamp Ballasts
  - d. C136; American National Standard for Roadway and Area Lighting Equipment
2. California Codes of Regulations
  - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
  - b. Part 6 -California Energy Code
3. IESNA –Illuminating Engineering Society of North America
  - a. RP-16; Nomenclature and Definitions for Illuminating Engineering
4. NECA –National Electrical Contractors Association
  - a. NECA/IESNA 500, Recommended Practice for Installing Indoor Commercial Lighting Systems

- b. NECA/IESNA 501, Recommended Practice for Installing Exterior Lighting Systems
- c. NECA/IESNA 502, Recommended Practice for Installing Industrial Lighting Systems
- 5. UL -Underwriter's Laboratories, Inc.
  - a. 935; Standard for Fluorescent-Lamp Ballasts
  - b. 1029; Standard for High-Intensity-Discharge Lamp Ballasts
  - c. 1574; Standard for Track Lighting Systems

### **1.03 SUBMITTALS**

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.
- B. Substituted fixtures shall be submitted with manufacturer's specification sheet and published photometric reports, verified by testing to IES and NEMA standards under controlled laboratory conditions.

### **1.04 QUALITY ASSURANCE**

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.
- B. Installation shall conform to the following standards:
  - 1. NECA/IESNA 500, Recommended Practice for Installing Indoor Commercial Lighting Systems
  - 2. NECA/IESNA 501, Recommended Practice for Installing Exterior Lighting Systems
  - 3. NECA/IESNA 502, Recommended Practice for Installing Industrial Lighting Systems

### **1.05 DELIVERY, STORAGE AND HANDLING**

- A. Handle carefully to avoid damage to internal components, enclosure and finish.
- B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

### **1.06 WARRANTY**

- A. Furnish one-year guarantee in accordance with and in form required under Section 26 05 00.

## **PART 2 - PRODUCTS**

### **2.01 GENERAL**

- A. Fixtures shall be of the types, wattages and voltages shown on Drawings.

- B. Fixtures shall be UL listed as an entire assembly and for the installed location.
- C. Fixtures' mounting trim shall be compatible with ceiling material, coordinate with Drawings for each location. Fixtures delivered which are not compatible shall be returned and replaced at Contractor's expense.
- D. Luminaire recessed in fire rated ceiling shall conform to UL Standards, equipped with yoke where in tee ceiling and field fabricated fire protection box in accordance with latest UL Fire Resistance Directory.
- E. Fluorescent luminaire lenses shall be Pattern 12 of 100% virgin acrylic with 0.125" thickness except shown or specified otherwise.
- F. Equip exposed fluorescent lamps with safety lamp holders or wire guard.
- G. Deliver fixtures and other lighting equipment complete with suspension accessories, canopies, castings, sockets, holders, reflectors, ballasts, diffusing material, louvers, frames, and recessing boxes all wired and assembled.
- H. Hangers: Swivel-type to allow for free movement of 45 degrees from vertical at canopy and at luminaire housing. Steel tube hangers shall include a 1/16-inch diameter galvanized wire cord or equivalent (100-pound break strength) in stem assembly attached to luminaire housing and building structure. Attach loop with C-type tool applied compression splice.
- I. All metal halide lamp luminaires shall be the enclosed type with diffuser or lens to withstand an arc tube rupture.
- J. Louvers for fluorescent luminaires which are removable for re-lamping but not hinged shall be securely fastened near each end between the fixture housing and louvers using No. 16 jack chain.

## 2.02 BALLASTS

- A. Ballast(s) in luminaire recessed in fire rated ceiling shall be approved for such use.
- B. Ballast installed indoors shall be of encapsulated type for noise control.
- C. Use appropriate rated ballast in high or low temperature applications.
- D. Compact fluorescent and fluorescent lamp ballasts
  1. Ballasts shall be programmed rapid start.
  2. Ballasts shall be UL 935 listed, Class P, Type 1 Outdoor, CSA Certified where applicable.
  3. The ballast shall meet or exceed ANSI C82.11, where applicable.
  4. The ballast shall withstand transients specified within ANSI C62.41 Cat. A.
  5. THD (Total Harmonic Distortion) shall be less than 10%.
  6. Ballast power factor shall be greater than 98%.
  7. The ballast shall have an audible noise rating of Class A or better.
- E. High intensity discharge (HID) lamp ballasts

1. Ballasts shall be premium constant wattage (regulator stabilized) type, designed in accordance with all applicable ANSI specifications including ANSI C82.4 and UL 1029.
  2. Power factor shall be greater than 90%.
  3. Provide protective fusing with HID ballasts or HID fixtures.
- F. Lamps
1. Provide lamps in all lighting fixtures shown.
  2. Type as noted on the plans, T8 unless noted otherwise.
  3. Approved manufacturers are General Electric, Osram Sylvania or equal.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Locate all lighting fixtures by reference to Drawings.
- B. Report proposed changes for luminaire locations found necessary due to interference with structure, pipes, ducts, and other items to Owner's representative for direction before installation. Luminaires specified with overall lengths are subject to change. Adjust as directed by Owner's representative.
- C. Contractor shall be responsible to coordinate with ceiling installation trade. This will assure that proper fixture type will be furnished to match ceiling system specified.

#### **3.02 INSTALLATION**

- A. Luminaires shall be properly grounded per CEC Article 410, Parts 17 through 21.
- B. Luminaires recessed in fire rated ceilings shall be in accordance with UL Fire Resistance Directory.
- C. Install all luminaires true and plumb. Support and mount in accordance manufacturer's instructions and with CEC Article 410, Parts 16 and 76.

#### **3.03 ADJUSTING**

- A. Particular care shall be used to eliminate light leaks around edge of recessed fixture trims.

#### **3.04 CLEANING**

- A. Clean all glass and plastic and polish all visible metal parts before submitting job to Owner's representative for final acceptance. Remove all fingerprints and dirt from exposed surfaces. Replace scratched or damaged components at the Contractor's expense.

**END OF SECTION**

## **SECTION 31 11 00**

### **CLEARING AND GRUBBING**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. The work of this section consists of clearing, grubbing, grinding, transporting, removing and disposing of trees, stumps, roots, vegetation debris, and existing improvements, including curb, gutters, catch basins, storm drains, landscaping, fencing, utilities, and other protruding obstructions within the clearing limits.
- B. Protect trees, landscaping and shrubs that are not designated to be removed or near construction site that may be harmed by construction activities.

##### **1.2 RELATED WORK**

- A. Section 02 41 00 – Demolition
- B. Section 31 23 00 – Earthwork

##### **1.3 REGULATORY REQUIREMENTS**

- A. Obtain all required permits.
- B. Dispose of removed materials in a legal manner at an approved disposal facility.

##### **1.4 REFERENCES**

- A. Section 15 – Existing Facilities, State Standard Specifications
- B. Section 19 – Earthwork, State Standard Specifications

#### **PART 2 PRODUCTS**

##### **2.1 NOT USED**

#### **PART 3 EXECUTION**

##### **3.1 CLEARING AND GRUBBING**

- A. Clear the specified areas by removing, above the natural ground surface, all existing improvements including curbs, gutters, catch basins, storm drains, landscaping fencing and utilities; vegetable growth such as trees, shrubs, logs, upturned stumps, roots of down trees, brush, and similar material.

1. Trees of 4-inch diameter and larger shall not be removed without Owner's authorization.
- B. Grub the specified areas below the natural ground surface, except in embankment areas where the grading plane is two feet or more above the natural ground, to a depth necessary to remove all boulders, stumps, roots, buried logs, and other objectionable material including rock and concrete. Remove and stock pile the top 4 inches of topsoil in any area which is to receive structural fill.

### 3.2 *PRESERVATION*

- A. If indicated or required, preserve trees, plants, rock outcroppings, or other features designated to remain. Protect trees and plants from damage; fell trees in a manner which shall not injure standing trees, plants and improvements which are to be preserved.

### 3.3 *SALVAGE EQUIPMENT*

- A. Salvaged equipment shall be delivered to the Owner at a designated site.
- B. Equipment to be salvaged is designated in Section 02 41 00, Demolition:

**END OF SECTION**

## **SECTION 31 23 00**

### **EARTHWORK**

#### **PART 1 GENERAL**

##### *1.1 WORK INCLUDED*

- A. Excavate earth and rock as necessary to allow the installation or construction of various items of work, regardless of character and subsurface conditions.
- B. Haul, place, rough grade, compact, and finish grade excavated material as engineered fill on those portions of the project site where it is necessary in order to construct the facilities indicated on the Plans.
- C. Dispose of unsuitable material off-site or in designated areas, as directed by the Engineer.
- D. Prepare excavation and fill for compaction testing.

##### *1.2 RELATED WORK*

- A. Section 31 11 00 – Clearing and Grubbing
- B. Section 31 22 19 – Finish Grading

##### *1.3 REFERENCES*

- A. ANSI/ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.
- B. ANSI/ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft lbf/ft<sup>3</sup> (600 kN m/m<sup>3</sup>))
- C. ANSI/ASTM D1557 – Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 10 lb (4.54 kg) Hammer and 18-inch (457 mm) Drop.
- D. ANSI/ASTM D1556 – Density of Soil and base rock in Place by Sand-Cone Method.
- E. ASTM D75 Standard Practice for Sampling Aggregates
- F. ASTM D 6938 – Density of soil and base rock in place by Nuclear method.
- G. ASTM D 2937 – Density of soil and in place by Tube method.
- H. Section 26 – Aggregate Bases, State Standard Specifications.
- I. Section 15 – Existing Facilities, State Standard Specifications

- J. Section 18 – Dust Palliatives, State Standard Specifications
- K. Section 19 – Earthwork, State Standard Specifications
- L. Geotechnical Engineering Investigation entitled, Geotechnical Investigation Report Proposed Cantua Creek and El Porvenir Pipeline Improvements Fresno County, CA by Kleinfelder Inc., dated November 20, 2017.

#### 1.4 PROTECTION

- A. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from falling into excavation.
  - 1. Trenches shall have sloping, sheeting, shoring, and bracing conforming with 29CFR1926, Subpart P – Excavations, CAL/OSHA requirements, and the Contract Documents.
- B. Notify Engineer of unexpected subsurface conditions.
- C. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.
- D. Grade excavation top perimeter to prevent surface water run-off into excavation.

#### 1.5 CONTROL AND DIVERSION OF WATER

- A. General – The Contractor shall furnish or procure all materials and labor required for constructing and maintaining all necessary cofferdams, channels, flumes, drains, sumps, and/or other temporary diversion and protective works and shall furnish, install, maintain, and operate all necessary pumping and other equipment for removal of water from the various parts of the work and for maintaining the foundations and other parts of the work free from water.
- B. Plan – Prior to beginning any work on the removal of water from foundations, the Contractor shall submit for the Engineer's approval a water control plan showing his proposed method for the removal of water from foundations and other parts of the work.

#### 1.6 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit plans as required for work protection against caving ground in excavation. Designs for shoring, bracing, sloping, or similar provisions shall bear the seal of a registered civil or structural engineer licensed to practice in the State of California.

#### 1.7 SAMPLES

- A. Submit samples under provisions of General Provisions.



- B. As specified in Section 01 33 00 – Submittal Procedures

#### 1.8 *QUALITY ASSURANCE*

- A. Compaction Testing

- 1. Compaction testing will be performed in accordance with State Standard Specifications, Section 19-6.03.

#### 1.9 *DEFINITION*

- A. Unsuitable Material: Unsuitable material is material determined to be:

- 1. Impossible to compact to specified density using ordinary methods at optimum moisture content.
  - 2. Too wet to be properly compacted if circumstances prevent satisfactory in-place drying prior to incorporation into the work.
  - 3. Otherwise unsuitable for the planned use.

#### 1.10 *PROJECT CONDITIONS*

- A. Underground utilities may exist at this site. Contractor shall take all necessary precautions to protect said utilities. Notify Engineer of any deviation in utility location from that which is shown on the drawings.
- B. Arrange construction sequences to provide the shortest practical time that trenches will be open to avoid hazard to the public, and to minimize the possibility of trench collapse.
- C. Obtain all required permits and licenses before installing utilities and follow the rules and requirements of the authority having jurisdiction.

#### 1.11 *EXCAVATION CLASSIFICATION*

- A. Regardless of the nature of material excavated, all excavation will be considered unclassified.

#### 1.12 *HAND EXCAVATION*

- A. Hand excavation will be required within the drip line of selected trees. The Engineer will designate these trees and will direct the performance of said hand excavation.
- B. Unless directed by the Engineer, roots two inches in diameter or larger shall not be cut.

**PART 2 PRODUCTS**

2.1 GENERAL

- A. All backfill material shall be approved before use and be free of cinders, ashes, ice, frozen soil, large hard clods, organic debris, or other deleterious items.
- B. Engineered fill materials for all fill areas shall be as required by State Standard Specifications, Section 19-6.
- C. Gravel: Pit run, natural stone; free of shale, clay, organic matter; No. 8 minimum to  $\frac{3}{8}$ " maximum size per State Standard Specifications, Section 90-1.02C(4)(a).
- D. Pea Gravel: Natural stone; washed, free of clay, shale, organic matter;  $\frac{1}{4}$ " minimum to  $\frac{5}{8}$ " maximum size.
- E. Sand: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter, graded in accordance with State Standard Specifications, Section 90-1.02C(4)(C), within the following limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
No. 4	75 - 100
No. 200	0 – 10

- F. Imported sand shall have a Sand Equivalent of 30, per ASTM D 2419.
- G. Class 2 Aggregate Base: Material as specified for  $\frac{3}{4}$ " maximum grading in State Standard Specifications Section 26-1.02B, unless otherwise specified.
- H. Permeable material for use in backfilling under, around, and over underdrains; and permeable material for chimney drains, riprap bedding, or other subdrainage purposes shall consist of hard, durable, clean sand, gravel or crushed stone and shall be free from organic materials, clay balls, or other deleterious substances.

- 1. The percentage composition by weight of permeable materials in-place shall conform to the following gradation when determined by ASTM D-422:

<u>Sieve Size</u>	<u>Percent Passing</u>
1½ inch	90-100
¾ inch	45-75
No. 4	30-45
No. 50	4-10
No. 100	1-3
No. 200	0-2

## 2.2 MATERIALS FOR EMBANKMENTS

- A. Unless otherwise specified, embankment and backfill material shall be as required by State Standard Specifications Section 19, Earthwork.
- B. Embankment material shall contain no rock or hard lumps larger than three inches at greatest dimension. If expansive clays are present, such content shall not exceed one-third of the material by volume, and shall be well mixed with non-cohesive soils
- C. Embankment material for embankments shall be selected to the maximum practical extent from excavation. Deficiency of material, if any, may be made up from other sources, as approved by the Engineer.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Identify required lines, levels, contours, and datum.

### 3.2 MOISTURE CONTROL

- A. Water development, hauling, and application shall be in accordance with State Standard Specifications Section 10-6, Watering.

### 3.3 CLEARING AND GRUBBING

- A. All surface vegetation and any miscellaneous surface obstructions should be removed from the project area prior to any site grading in accordance with Section 31 11 00, "Clearing and Grubbing" and the Geotechnical Report (see Appendix).

### 3.4 OVER-EXCAVATION

- A. Excavate disturbed soil, undocumented fill and subsurface obstructions to expose firm native material. Excavation shall include earth and rock, as necessary, to allow the installation or construction of various items of work.
- B. Over-excavate to a minimum depth of 12 inches, scarify, and re-compact the near surface soil within the entire limits of improvements as specified in the Geotechnical Report (see Appendix).

### 3.5 EXCAVATION

- A. Excavate the specified areas as shown.
- B. If the Plans require placement of fill prior to pipe, or structure excavation, the fill shall first be constructed to the design grade shown for a distance each side of the pipe or structure of not less than five times the diameter of the pipe or the width of

the structure after which the trench shall be excavated and the pipe or structure installed.

### 3.6 *ENGINEERED FILL AND EMBANKMENT CONSTRUCTION*

- A. Unless otherwise noted, placement and compaction of engineered fill materials for all fill areas shall be performed according to the provisions of the State Standard Specifications, Section 19-6. Section 19-6.02A shall be amended to say that large rocky material or hard lumps large than three inches in greatest dimension will not be allowed.
- B. Before placing embankment, scarify ground surface to provide ample bond between old and new material, as shown on the Plans. Place embankment material in layers not exceeding eight inches, loose measurement.
- C. Compaction shall be in accordance with State Standard Specifications, Section 19-5. Compact each layer before placing the next layer. As the compaction of each layer progresses, continually level and manipulate to ensure uniform moisture and density. Add water to obtain optimum moisture content. Removal of excess water shall be accomplished through aeration by plowing, blading, disking, or other methods satisfactory to the Engineer.
- D. The native soils at the project location contain extensive cemented zones. The contractor shall apply the necessary effort to achieve the specified particle size control within the material placed in the embankment prism.

### 3.7 *EXCAVATION FOR BUILDINGS, CONCRETE TANKS AND OTHER CONCRETE STRUCTURES*

- A. Excavate for all foundations, slabs, curbs, walks and/or similar work. Remove any curbs, slabs, paving, trees, bushes, shrubs, stumps, roots, buried objects, or any objects that interfere with construction of building foundations, or as required by the Engineer.
- B. Excavations for all footings, piers, finished walls and grade beams shall be sufficiently large so that forms for concrete may be properly placed, removed, and inspected.
- C. Excavation for footings may be made to the net footing size plus two inches if the earth banks are sufficiently stable to remain in position until the concrete is in place and if approved by the Engineer.
- D. The bottoms of footings, piers, slabs, walls, and grade beams to receive concrete shall be level before placing concrete. All foundations shall rest on firm bearing in undisturbed soil, or on controlled compacted fill.
  - 1. The exposed surface shall be scarified to a depth of eight inches, conditioned to at least 4% above optimum moisture content and compacted to between 88% - 92 percent of the maximum dry density.

- E. If any existing foundations, roots, stumps, debris, waste materials, pipes, or similar items have been removed, the Contractor shall excavate below these portions to solid undisturbed earth and foundations in these areas shall be built to necessary levels.
- F. If soil conditions in excavations are not as shown in the geotechnical report, and appear to indicate that footings need not be carried down as deep as shown, or must be carried deeper, the changes shall be made by the Contractor after approval by the Engineer.

### 3.8 SHORING AND SHEETING

- A. Construct and maintain all shoring, sheeting, and slope layback necessary to protect the excavation, as needed, for the safety of the employees and as required by applicable State and Federal laws. Provide suitable barricades for public safety, regardless of trench depth.

### 3.9 DEWATERING

- A. The Contractor shall keep all excavation free from water. Furnish, install, maintain, and operate all necessary pumping and other equipment for dewatering of excavations. The Contractor shall at all times have on the project sufficient pumping equipment for immediate use, including stand-by pumps for use in case other pumps become inoperable.
- B. The dewatering operation shall be continuous, so that the excavated areas are kept free from water during the construction, until backfill has been placed to a sufficient height to anchor the work against possible floatation.
- C. Dewatering devices shall be adequately filtered to prevent the removal of fines from the soil.
- D. Repair any damage caused by the failure of any part of the protective works. Remove temporary protective works when they are no longer needed for dewatering purposes.
- E. Any drain rock required in the trench bottom to convey water or stabilize wet soil shall be included at no extra cost to the Owner.
- F. Provision of dewatering and dewatering equipment shall be considered part of the project with no additional compensation allowed.

### 3.10 SURPLUS MATERIAL

- A. Unless otherwise specified, surplus excavated material shall be used to widen embankments uniformly or to flatten slopes,

### 3.11 UNSUITABLE MATERIAL

- A. Unsuitable material shall be excavated and disposed of in a lawful manner off the project site, all disposal shall be approved by the Engineer prior to initiating the work.

### 3.12 SURFACE FINISH WORK

- A. Paved Areas: Replace removed paving and base course with new material of equal or better quality and of the same texture and color as the adjacent paved areas. Saw cut pavement edges to a true line and broom as needed prior to repaving.
- B. Open Areas: Grade all disturbed areas, blending with adjacent terrain. Minor irregularities will be permitted.
- C. Drainage Ditches: Restore drainage ditches to appropriate line and grade, using approved surface erosion prevention techniques.
- D. Clean Up: Remove all rubbish and excess material for disposal as approved, and leave area in a neat, satisfactory condition.

### 3.13 TOLERANCES

- A. Top Surface of Backfilling:  $\pm 0.10$  foot from design grade.
- B. Aggregate Base Subgrade:  $\pm 0.05$  foot from design grade.

**END OF SECTION**

## SECTION 31 23 17

### TRENCHING, BACKFILLING AND COMPACTING

#### PART 1 GENERAL

##### 1.1 WORK INCLUDED

- A. This section includes material, testing, and installation for trench excavation, backfilling and compacting.

##### 1.2 RELATED WORK

- A. Section 31 11 00 – Clearing and Grubbing
- B. Section 31 23 00 – Earthwork
- C. Section 33 10 00 – Domestic Water System
- D. Section 40 05 00 – Pipe and Fittings

##### 1.3 REFERENCES

- A. ANSI/ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.
- B. ANSI/ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft lbf/ft<sup>3</sup> (600 kN m/m<sup>3</sup>))
- C. ANSI/ASTM D1557 – Moisture-Density Relations of Soils and Sol-Aggregate Mixture Using 10 lb (4.54 kg) Hammer and 18-inch (457 mm) Drop.
- D. ANSI/ASTM D1556 – Density of Soil and base rock in Place by Sand-Cone Method.
- E. ASTM D 6938 – Density of soil and base rock in place by Nuclear method.
- F. ASTM D 2937 – Density of soil and in place by Tube method.
- G. Section 26 – Aggregate Bases, State Standard Specifications.
- H. Geotechnical Engineering Investigation entitled, Geotechnical Investigation Report Proposed Cantua Creek and El Porvenir Pipeline Improvements Fresno County, California, dated November 20, 2017.

##### 1.4 SUBMITTALS

- A. Submittals shall be in accordance with the General Provisions
- B. As specified in Section 01 33 00 – Submittal Procedures

Trenching, Backfilling, and Compacting  
31 23 17-1

## 1.5 SAMPLES

- B. Submit samples under provisions of Standard General Conditions.

## 1.6 PROTECTION

- A. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from falling into excavation.
  - 1. Trenches shall have sloping, sheeting, shoring, and bracing conforming with 29CFR1926, Subpart P—Excavations, CAL/OSHA requirements, and the Contract Documents.
- B. Notify Engineer of unexpected subsurface conditions.
- C. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.
- D. When the pipe laying is not in progress, including the noon hours, close the open ends of pipe. Do not allow trench water, animals or foreign material to enter the pipe.

## 1.7 QUALITY ASSURANCE

- A. Compaction Testing

All compaction testing shall be in accordance with State Standard Specifications Section 19-6.03

## 1.8 CONTROL AND DIVERSION OF WATER

- A. General – The Contractor shall furnish or procure all materials and labor required for constructing and maintaining all necessary cofferdams, channels, flumes, drains, sumps, and/or other temporary diversion and protective works and shall furnish, install, maintain, and operate all necessary pumping and other equipment for removal of water from the various parts of the work and for maintaining the foundations and other parts of the work free from water.
- B. Plan – Prior to beginning any work on the removal of water from trenches, the Contractor shall submit for the Engineer's approval a water control plan showing his proposed method for the removal of water from trenches and other parts of the work.
- C. Dispose of the water in a manner that will prevent damage to the adjacent property and in accordance with regulatory requirements.
- D. Do not drain trench water through the pipeline under construction.



## 1.9 PROJECT CONDITIONS

- A. Underground utilities may exist at this site. Contractor shall take all necessary precautions to protect said utilities. Notify Engineer of any deviation in utility location from that which is shown on the drawings.
- B. Obtain all required permits and licenses before installing utilities and follow the rules and requirements of the authority having jurisdiction.
- C. Arrange construction sequences to provide the shortest practical time that the trenches will be open to avoid hazard to the public, and to minimize the possibility of trench collapse.

## PART 2 MATERIALS

### 2.1 MATERIALS FOR TRENCH BACKFILLING

- A. Furnish required bedding, select backfill and backfill materials listed under the appropriate types of utility line in the sections to which this work relates.
- B. All fill material will be subject to the approval of the Engineer.
- C. Materials used in backfill, as shown in trench details, are defined as follows:

- 1. Bedding: When rock, unstable material, or wet trench is encountered at the excavated grade for utility installation, bedding is required. Materials shall be predominantly sand and gravel, having a plasticity index less than 6. Bedding may be omitted if, in the opinion of the Engineer, the excavated trench bottom will adequately support and not damage the utility line.

- a. Gradation as follows:

<u>Sieve Size</u>	<u>Percent Passing</u>
½ inch	100
No. 4	50-80
No. 200	10-25

- b. Bedding material shall have a sand equivalent of 30 per ASTM D 2419.

- 2. Select Backfill: Materials shall be predominantly sand and gravel, having a plasticity index less than 6.

- a. Gradation as follows:

<u>Sieve Size</u>	<u>Percent Passing</u>
1½ inch	100
No. 4	50-80
No. 40	10-25

- b. Select backfill material shall have a sand equivalent of 30 per ASTM D 2419.
3. Backfill: Soils that contain no rock larger than 3 inches at greatest dimension. If expansive clays are present, such content shall not exceed one-third of the material by volume, and shall be well mixed with non-cohesive soils.

**2.2 SELECT AND IMPORT MATERIAL IN PIPE AND BEDDING ZONE**

- A. Gravel: Pit run, natural stone; free of shale, clay, friable materials and debris; graded in accordance with 1½" x ¾" aggregate grading in Section 90-3, State Standard Specifications.
- B. Pea Gravel: Natural stone; washed, free of clay, shale, organic matter; 1/4-inch minimum to 5/8-inch maximum size.
- C. Sand: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter, graded in accordance with Section 90-3, State Standard Specifications, within the following limits:

<b>Sieve Size</b>	<b>Percent Passing By Weight</b>
No. 4	75 – 100
No. 200	0 - 10

- D. Imported sand shall have a sand equivalent of 30 per ASTM D 2419.

**2.3 NATIVE EARTH BACKFILL**

- A. Native earth backfill used above the pipe zone shall be fine-grained materials free from roots, debris, and rocks larger than 3 inches.

**2.4 SAND-CEMENT SLURRY**

- A. Sand-cement slurry backfill shall be as specified in Section 03 30 01 – Cast in Place Concrete.

## 2.5 WATER FOR COMPACTION

- A. Water shall be free of organic materials injurious to the pipe coatings, have a pH of 7.0 to 9.3, maximum chloride concentration of 500 mg/l, and a maximum sulfate concentration of 500 mg/l.

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Excavation, grading and compaction shall conform to the requirements of Section 19 of the State Standard Specifications.

### 3.2 INSPECTIONS

- A. Verify stockpiled material has been approved for reuse.
- B. Verify areas to be backfilled are free of debris, snow, ice, or water, and surfaces are not frozen.

### 3.3 PREPARATION

- A. Identify required lines, levels, contours, and datum.

### 3.4 AC PAVEMENT AND CONCRETE REMOVAL

- A. Cut bituminous and concrete pavements, regardless of the thickness, curbs, gutters and sidewalks prior to excavation of trenches.
  - 1. Width of material removed shall be at least equal to the required width of the trench at ground surface.
  - 2. Width of material removed shall be as shown on the Plans
  - 3. AC pavement and concrete rubble shall not be used for trench backfill.

### 3.5 EXCAVATION

- A. Excavate the trench to the lines and grades shown on the Drawings for storm sewer, sanitary sewer, water, and other utilities and points of connection, with allowance for pipe thickness, sheeting and shoring if used, and for special bedding.
- B. Paved Areas: Cut existing pavement to full depth to a true line before excavation and maintain the edge suitable for repaving. Pavement removed shall not be used as backfill.

- C. Trenching Guidelines: Excavate the trench to the approximate level of the grade of the utility line to be installed, using adequate trench width and side slopes to safely accommodate worker access.
  - 1. Rocky Trench Bottom: Where ledge rock, hard pan, boulders, or sharp-edged materials are encountered, over excavate a minimum depth of 6 inches below the bottom of the utility exterior wall to permit adequate bedding preparation. The installed utility shall have at least 6 inches of clearance from any rock protrusion.
    - a. Unstable Trench Bottom: Secure approval of depth of over-excavation and stabilization method. For wet trench construction, use approved method of dewatering through diversion, damming and pumping, well points, or underdrain systems. Dispose of removed fluidized materials as approved. Use bedding material to build a suitable foundation to within 6 inches of finished utility grade, prior to bedding with the specified material. Compact layers to 95 percent of maximum density in not greater than 6-inch layers. Do not proceed with utility installation until wet trench and unstable conditions are corrected to the satisfaction of the Engineer.
- D. Remove areas of sub-grade not readily capable of it-situ compaction.
  - 1. Backfill with Bedding or Select Backfill material and compact to density equal to requirements for subsequent backfill.
- E. Correct unauthorized excavation at no cost to Owner.
  - 1. If the trench is excavated below the required grade, refill any part of the trench excavated below the grade.
  - 2. Place the refilling material over the full width of trench in compacted layers not exceeding eight inches deep to the established grade with allowance for special bedding.
- F. Trench widths in the pipe zone shall be as shown on the drawings. If no details are shown, maximum width shall be 24 inches greater than the pipe outside diameter.
  - 1. Trench width at the top of the trench will not be limited except where width of excavation would undercut adjacent structures and footings. In such case, width of trench shall be such that there is at least two feet between the top edge of the trench and the structure or footing.
- G. Hand trim for bell and spigot pipe joints.
- H. Remove lumped soil, boulders and rock.
- I. Excavation shall not interfere with normal 45 degree bearing splay of foundations.

- J. During trench excavation, place the excavated material only within the working area. Do not obstruct roadways or streets. Conform to federal, state, and local codes governing the safe loading of trenches with excavated material.
- K. Foundation stabilization
  - 1. After the required excavation has been completed, the Engineer will inspect the exposed subgrade to determine the need for any additional excavation. It is the intent that additional excavation be conducted in all areas within the influence of the pipeline where unsuitable materials exist at the exposed subgrade. Over excavation shall include the removal of all such unacceptable material that exists directly beneath the pipeline to a width 24 inches greater than the pipe outside diameter and to the depth required.
  - 2. Rock refill used by the Contractor for his convenience will not receive any additional payment.

### 3.6 *UTILITY INSTALLATION*

- A. Utility Installation: Shape the trench bottom to ensure uniform contact with the full length of the installed line and remove any sharp-edged materials that might damage the line. Compaction shall be maintained beneath the line.

### 3.7 *LENGTH OF OPEN TRENCH*

- A. Limit the length of open trench to 600 feet in advance of pipe laying or amount of pipe installed in one working day.
- B. Complete backfilling, temporary or first layer paving, not more than 400 feet in the rear of pipe laying operation.
- C. In County right of way, roads shall be re-opened to traffic at the end of each work day. This may be accomplished by backfilling and compacting trenches and placing temporary trench resurfacing or using trench plates.

### 3.8 *TRENCH EXCAVATION IN EMBANKMENT AREAS*

- A. Construct and compact the embankment to an elevation one foot, minimum, over the top of the largest pipe or conduit to be installed prior to trench excavation.

### 3.9 *UNSUITABLE MATERIAL*

- A. Unsuitable material shall be excavated and disposed of in a lawful manner off the project site, all disposal shall be approved by the Engineer prior to initiating the work.

### 3.10 *DEWATERING*

- A. The Contractor shall keep all excavation free from water. Furnish, install, maintain, and operate all necessary pumping and other equipment for dewatering

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of excavations. The Contractor shall at all times have on the project sufficient pumping equipment for immediate use, including stand-by pumps for use in case other pumps become inoperable.

- B. The dewatering operation shall be continuous, so that the excavated areas are kept free from water during the construction, until backfill has been placed to a sufficient height to anchor the work against possible floatation.
- C. Dewatering devices shall be adequately filtered to prevent the removal of fines from the soil.
- D. Repair any damage caused by the failure of any part of the protective works. Remove temporary protective works when they are no longer needed for dewatering purposes.
- E. Any drain rock required in the trench bottom to convey water or stabilize wet soil shall be included at no extra cost to the Owner.
- F. Provision of dewatering and dewatering equipment shall be considered part of the project with no additional compensation allowed.

### 3.11 BACKFILLING

- A. Support pipe during placement and compaction of bedding fill.
- B. Backfilling and cleanup work shall be accomplished as sections of pipe or conduit are tested and approved. Vehicular travel through the work site shall be impeded or obstructed as little as possible.
- C. Compaction: Use vibratory compactors for sands and gravels (non-cohesive soils). Use mechanical tampers for sand and gravel containing a significant portion of fine-grained materials, such as silt and clay (cohesive soils). Hand tamp around pipe or cable to protect the lines until adequate cushion is attained. Puddling or water flooding for consolidation of backfill or compaction by wheel rolling will not be permitted.
  - 1. Employ a placement method that will not disturb or damage pipe or utilities.
  - 2. Maintain optimum moisture content of backfill materials to attain required compaction density.
  - 3. Compact trench backfill to the specified relative compaction. Compact by using mechanical compaction or hand tamping. Do not use high impact hammer type equipment except where the pipe manufacturer warrants in writing that such use will not damage the pipe.
  - 4. Compact material placed within 12 inches of the outer surface of the pipe by hand tamping only.

- a. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe.
  - b. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling.
5. After pipe has been bedded, place pipe zone material simultaneously on both sides of the pipe, in maximum 8-inch lifts, keeping the level of backfill the same on each side.
  6. Do not use any axle-driven or tractor-drawn compaction equipment within 5 feet of building walls, foundations, and other structures.
  7. Do not permit free fall of the material until at least two feet of cover is provided over the top of the pipe. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe. Do not operate heavy equipment over the pipe until at least 3 feet of backfill has been placed and compacted over the pipe.
  8. Remove surplus backfill materials from site.
  9. Leave stockpile areas completely free of excess fill materials.
- D. Bedding: Unless otherwise specified, compact the specified material to 95 percent of maximum density to the finished utility grade.
- E. Select Backfill: Fill by hand placement around the utility to just over half depth, and compact in a manner to ensure against lateral or vertical displacement. Place select backfill to 12 inches above the utility line by hand placement in not more than 6-inch layers.
- F. Backfill: To minimize settling, soils shall be backfilled in layers, with each layer compacted prior to addition of the next layer. Unless otherwise specified, place and compact the specified material as follows:
1. Vehicular Traffic Areas: Fill and compact in 8-inch maximum layers as follows:
    - a. From top of select backfill to 2 feet below top of subgrade – 90 percent of maximum density.
    - b. From 2 feet below top of subgrade to top of subgrade – 95 percent of maximum density/
- G. Non-traffic Areas: Fill and compact in 8-inch maximum layers to 90 percent of maximum density.

**3.12 SHORING AND SHEETING**

- A. Construct and maintain all shoring, sheeting, and slope layback necessary to protect the excavation, as needed, for the safety of the employees and as required by applicable State and Federal laws. Provide suitable barricades for public safety, regardless of trench depth.

**3.13 TOLERANCES**

- A. Top Surface of Backfilling:  $\pm 0.1$  foot.

**3.14 SAND CEMENT SLURRY, CONCRETE ENCASEMENT AND THRUST BLOCKS**

- A. Place in accordance with the Contract drawings.

**3.15 COMPACTION REQUIREMENTS**

- A. Relative compaction requirements shall be as shown on the Plans.

**3.16 TRENCH RESURFACING**

- A. Trench resurfacing shall be in accordance with Section 32 12 16 – Asphalt Concrete Paving.

**END OF SECTION**



## **SECTION 31 23 35**

### **DISPOSAL OF MATERIALS**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. Disposal of unsuitable material, concrete, asphalt concrete, rubbish, and other debris, as described below.

##### **1.2 RELATED WORK**

- A. Section 03 33 00 – Cast-In-Place Concrete
- B. Section 31 11 00 – Clearing and Grubbing
- C. Section 31 23 00 – Earthwork
- D. Section 31 23 34 – Pipe Earthwork

##### **1.3 REFERENCES**

- A. ASTM D75 – Practice for Sampling Aggregates.
- B. ANSI/ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.
- C. ANSI/ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft lb/ft<sup>3</sup> (600 kN m/m<sup>3</sup>))
- D. ANSI/ASTM D1557 – Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 10 lb (4.54 kg) Hammer and 18-inch (457 mm) Drop.
- E. ANSI/ASTM D1556 – Density of Soil and base rock in Place by Sand-Cone Method.
- F. ASTM D 2922 and D 3017 – Density of soil and base rock in place by Nuclear method.
- G. ASTM D 2937 – Density of soil and in place by Tube method.
- H. Section 26 – Aggregate Bases, State Standard Specifications.
- I. Section 16 – Clearing and Grubbing, State Standard Specifications
- J. Section 17 – Watering, State Standard Specifications
- K. Section 19 – Earthwork, State Standard Specifications

- L. *Geotechnical Engineering Investigation* entitled, *Geotechnical Investigation Report Proposed Cantua Creek and El Porvenir Improvements, Fresno County, CA* by Kleinfelder Inc., dated November 20, 2017.

#### 1.4 SUBMITTALS

- A. Submittals shall be in accordance with the General Provisions.
- B. As specified in Section 01 33 00 – Submittal Procedures

#### 1.5 GENERAL

- A. The Contractor shall be responsible for the cleanup and disposal of waste materials and rubbish. The disposal of waste materials and rubbish shall be in accordance with applicable Federal, State, and local laws and regulations, and with the requirements of this paragraph. Should a conflict exist in the requirements for cleanup and disposal of waste materials, the most stringent requirement shall apply.
- B. The Contractor shall keep records of the types and amounts of waste materials produced, and of the disposal of all waste materials on or off the jobsite.
- C. The cost of disposing of waste materials other than unsuitable materials shall be included in the prices bid in the schedule for other items of work.

### **PART 2 PRODUCTS**

Not Used

### **PART 3 EXECUTION**

#### 3.1 DISPOSAL OF EXCAVATED MATERIAL

- A. All excess excavated material shall be hauled off site to a location selected by the Contractor, meeting the conditions of Paragraph 3.4 below.
- B. All unsuitable material shall be hauled off-site and properly disposed.

#### 3.2 DISPOSAL OF CONCRETE AND A. C. SURFACING

- A. All concrete, A.C. and pavement removed from the project site shall be disposed of at a site obtained by the Contractor and approved by the Owner's Representative. No recyclable material shall be disposed of at any landfill. All disposable recyclable materials shall be disposed in a manner that facilitates recycling. Payment for disposal, including all costs of hauling, shall be as specified in the Technical Specifications or Explanation of Bid Items. The Contractor shall report quantities of disposed material in a manner that enables the Owner to utilize diverted quantities as diversion credits pursuant to California Integrated Waste Management Act of 1989 (Public Resources Code Sections 40000 et seq.)

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### 3.3 *DISPOSAL OF OTHER DEBRIS*

- A. All oil cake, wood debris, structure demolition, vegetation and any other debris removed from the project site shall be legally disposed of at a site(s) obtained by the Contractor with prior written permission of the Owner's Representative. Contractor shall identify the proposed Disposal Site(s) at the pre-construction conference. Such Disposal Site(s) shall be a properly licensed and permitted facility pursuant to state and local regulations for purposes of accepting delivery of the respective materials. No recyclable material shall be disposed of at any landfill. All disposable recyclable materials shall be disposed in a manner that facilitates recycling. In addition to the following, a certificate of compliance stating disposal location and manner of disposal of recyclable materials shall be submitted to the Owner's Representative.
1. Disposal of combustible materials shall be by removal from the construction area. Disposal of combustible materials by burning will not be permitted. Disposal of waste materials by burying will not be permitted.
  2. Waste materials shall be disposed of or recycled at a State approved disposal or recycle facility. The Contractor shall make any necessary arrangements with private parties, and State and county officials pertinent to locations and regulations of such disposal or recycle facilities, and shall pay any fees or charges required for such disposition.

### 3.4 *CONTRACTOR'S DISPOSAL SITES*

- A. Contractor shall make arrangements for disposing of the materials at the Disposal Site(s) and pay all costs involved. Arrangements shall include, but not be limited to, obtaining written authorization from the property owner of the Disposal Site(s) and before disposing of any material off the project site, Contractor shall furnish to the Owner's Representative the authorization or a certified copy thereof together with a written release from the property owner absolving the Owner from any and all responsibility in connection with the disposal of material on the property of the Disposal Site(s). Before any material is disposed of on the Disposal Site(s), the Contractor shall obtain written permission from the Owner's Representative to dispose of the material at the location designated in the authorization.
- B. It is expressly understood and agreed that the Owner assumes no responsibility to the Contractor whatsoever by the granting of such permission and Contractor shall assume all risks in connection with the use of the Disposal Site(s). The Contractor is cautioned to make such independent investigation and examination as the Contractor deems necessary to be satisfied as to the quantity and types of materials which may be disposed of on the Disposal Site(s) and the status of any permits or licenses in connection therewith.
- C. Within 24 hours of removing the respective material from the project site for disposal, Contractor shall provide Owner's Representative with a certified copy of the weight slip from the Disposal Site obtained by Contractor upon delivery of such debris, and a certified statement from Contractor identifying the material

constituting the debris and that it was disposed of at the Disposal Site (identifying the and name of the owner) in accordance with all laws and applicable regulations promulgated by Federal, State, regional, or local administrative and regulatory agencies.

### 3.5 DISPOSAL OF HAZARDOUS WASTE AND MATERIALS

- A. Materials or wastes, defined as hazardous by 40 CFR 261.3, or by other Federal, State, or local laws or regulations, used by the Contractor or discovered in work or storage areas, shall be disposed of in accordance with these specifications and applicable Federal, State, and local laws and regulations. Unknown waste materials that may be hazardous shall be tested, and the test results shall be submitted to the Owner's Representative for review.
- B. Waste materials known or found to be hazardous shall be disposed of in approved treatment or disposal facilities. Hazardous wastes shall be recycled whenever possible. A copy of all hazardous waste manifest shall be sent to the Owner's Representative.
- C. Waste materials discovered at the construction site shall immediately be reported to the Owner's Representative. If the waste may be hazardous, the Owner's Representative may order delays in the time of performance or changes in the work, or both. If such delays or changes are ordered, an equitable adjustment will be made in the contract in accordance with the applicable clauses of the contract.
- D. If necessary, the Contractor will be required to conduct an environmental site assessment at the following Contractor use locations:
  - 1. All hazardous waste accumulation areas;
  - 2. All hazardous material and petroleum dispensing and storage areas where the aggregate storage of hazardous materials or petroleum at the site is or has been over 110 gallons.
  - 3. This site assessment shall be performed by a qualified environmental consultant or equivalent and shall document through appropriate analytical sampling that the site is free of the effects of contamination (i.e., contaminant concentrations less than State action cleanup levels).

### 3.6 CLEANUP

- A. In accordance with Standard General Conditions and Supplementary Conditions, the Contractor shall keep work and storage areas free from accumulations of waste materials and rubbish, and before completing the work, shall remove all plant facilities, buildings, including concrete footings and slabs, rubbish, unused materials, concrete forms, and other like materials, which are not a part of the permanent work.

- B. Upon completion of the work, and following removal of construction facilities and required cleanup, work areas shall be regraded and left in a neat manner conforming to the natural appearance of the landscape.

**END OF SECTION**

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**SECTION 32 11 23**  
**AGGREGATE BASE**

**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- A. Furnish, spread, and compact aggregate base in roadways, driveways and other paved areas as shown on the Plans.
- B. The work of this section consists of furnishing and placing aggregate base material and/or lean concrete base materials, and filler if required, on the prepared subgrade.

**1.2 RELATED WORK**

- A. Section 31 23 00 – Earthwork
- B. Section 31 22 19 – Finish Grading

**1.3 REFERENCES**

- A. Section 10-6 – Watering, State Standard Specifications.
- B. Section 26 – Aggregate Bases, State Standard Specifications.
- C. Section 28-2 - Lean Concrete Base, State Standard Specifications.
- D. ANSI/ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.
- E. ANSI/ASTM D1557 – Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 10 lb (4.54 kg) Hammer and 18-inch (457 mm) Drop.
- F. ANSI/ASTM D1556 – Density of Soil and Base Rock in Place by Sand-Cone Method.
- G. ASTM D6938 – Density of Soil and Base Rock in Place by Nuclear Method.

**1.4 SUBMITTALS**

- A. Submittals shall be in accordance with the General Provisions.
- B. As specified in Section 01 33 00 – Submittal Procedures

- C. If materials are obtained from a commercial source, submit certification from the supplier certifying that aggregate base course meets the requirements of this section.
- D. Copies of certified weight tickets for each load of aggregate delivered to the project site.

### 1.5 QUALITY ASSURANCE

- A. Relative Compaction:
- B. Sample backfill materials per ASTM D75.
- C. Compaction testing will be performed in accordance with Section 19-5 of the State Standard Specifications.
  - 1. Compaction testing of areas to be saw cut and replaced shall be one for every 300-LF of adjacent curb and gutter but not less than one for each curb cut area.
  - 2. The Contractor shall not proceed with work over the area being tested until results have been verified by the Engineer. Immediately upon completion of each compaction test, a copy of the results shall be given by the testing laboratory to the Engineer.
  - 3. Test every 10,000 square feet of engineered fill or aggregate base material placed. The Contractor shall not proceed with work over the area being tested until results have been verified by the Engineer. Immediately upon completion of each compaction test, a copy of the results shall be given by the testing laboratory to the Engineer.
- D. The percentage composition by weight shall conform to Class 2 aggregate base determined by Test Method No. Calif. 202, modified by Test Method No. Calif. 905 if there is a difference in specific gravity of 0.2 or more between the coarse and fine portion of the aggregate or between blends of different aggregates.
- E. Aggregate base shall also conform to the following quality requirements:

<u>Tests</u>	<u>Test Method Calif. No</u>
R-Value	301
Sand Equivalent	217
Durability Index	229

- F. Quality Control shall be under the provisions of Standard General Conditions and Supplementary Conditions.

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## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

#### **A. AGGREGATE BASE**

1. Class 2 Aggregate Base, ¾-inch maximum; as per Section 26-1.02B, State Standard Specifications.
2. Aggregate for Class 2 aggregate base shall be free from vegetable matter and other deleterious substances.

#### **B. LEAN CONCRETE BASE**

1. Lean Concrete Base shall conform to the State Standard Specifications, Section 28-4, Lean Concrete Base Rapid Setting.
2. State Standard Specifications Section 28-4.04 shall not apply.

#### **C. WATER**

1. At the time aggregate base is spread, it shall have a moisture content sufficient to obtain the require compaction. Such moisture shall be uniformly distributed throughout the materials.

## **PART 3 EXECUTION**

### **3.1 SUBGRADE PREPARATION**

- A. As specified in Sections 31 23 00, Earthwork.

### **3.2 SPREADING**

- A. The aggregate base course material shall be deposited and spread to the required compacted thickness by means that will maintain the uniformity of the mixture. The aggregate base course shall be free from pockets of coarse or fine material.
- B. Deliver aggregate base to the area to be paved as a uniform mixture and spread each layer in one operation.
- C. Aggregate base placed at locations which are inaccessible to the spreading equipment shall be spread in two layers by any means to obtain the specified results.
- D. The aggregate shall not be treated with lime, cement or other chemical materials before the Durability Index test has been performed.



- E. The surface of the finished aggregate base at any point shall not vary more than  $\pm 0.05$ -foot from the grade shown.

### 3.3 *PLACING*

- A. If the required compacted depth of the aggregate base course exceeds 6 inches, place course in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.

### 3.4 *MIXING*

- A. Mixing shall be in accordance with one of the methods set forth in State Standard Specifications, Section 28-4.03B.

### 3.5 *MOISTURE CONTROL*

- A. When spread, aggregate base shall have a moisture content sufficient to obtain the specified compaction.

### 3.6 *SURFACE FINISHING*

- A. Use a smooth steel wheel roller for the final rolling of top surface base course. Water surface and evenly spread loose stones before final rolling. Make minimum of two complete passes over area to embed stones. Correct soft spots developed during rolling.
- B. Compacted aggregate base course surface shall be smooth and free from waves and other irregularities. Unsatisfactory portions of base course shall be corrected, at no additional expense to the Owner.

### 3.7 *MATERIAL ACCEPTANCE REQUIREMENTS*

- A. Acceptance will be based on periodic samples and tests taken following mixing and before placing.

### 3.8 *TOLERANCES*

- A. Surface: The finished surface of the base course will be tested with a 10-foot straightedge or other device. The variation between any two contacts with the surface shall not exceed  $\pm 0.05$  feet.
- B. Width: Plan dimension,  $\pm 0.10$  feet.
- C. Thickness: Plan dimension,  $\pm 0.05$  feet.
- D. Any areas not complying with these tolerances shall be reworked to obtain conformity, at no additional expense to the Owner.

**3.9 MAINTENANCE**

- A. Maintain base course in a satisfactory condition until surfaced or until final acceptance.

**END OF SECTION**

Aggregate Base  
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## **SECTION 32 12 13**

### **BITUMINOUS PRIME AND TACK COAT**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. The work of this section consists of an application of asphalt cutback between asphalt layers. Applying a very light application of asphalt emulsion diluted with water as a tack between asphalt layers to create an adhesive surface for new asphalt concrete pavement to adhere to and applied to all existing vertical surfaces where new pavement is to be surfaced.

##### **1.2 RELATED WORK**

- A. Section 32 12 16 - Asphalt Concrete Paving.

##### **1.3 REFERENCES**

- A. Sections 37, 39, 93 and 94 - State Standard Specifications.

##### **1.4 SUBMITTALS**

- A. Submittals shall be in accordance with the General Conditions and Section 01 33 00 – Submittal Procedures.
- B. Two copies of manufacturer's certification for each load certifying the bituminous material is of the type, grade, and quality specified.
- C. One sample of asphalt cutback, in accordance with AASHTO T40-78, shall be taken for each load delivered to the project sites. Samples shall be stored in clean, airtight sealed containers at a temperature of not less than 40 degrees F, until tested.

##### **1.5 PROJECT CONDITIONS**

- A. Apply bituminous material only during daylight hours, when surface is dry, temperature is above 50 degrees F, and weather is not foggy or rainy.

## **PART 2 PRODUCTS**

### **2.1 BITUMINOUS TACK COAT**

- A. Asphalt for tack coat shall be RS-1 or RS-2, for Anionic asphalt emulsion or CRS-2 for Cationic asphalt emulsion.
  - 1. Engineer shall select which asphalt emulsion shall be used. Use tack coat between asphalt lifts only if applied surface has been in place over 24 hours, or has been in service.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. Protect the surface of sidewalks, curbs, other structures, and trees adjacent to the area being treated from being spattered or marred. If surfaces become spattered, clean in accordance with manufacturer's recommendations.
- B. Do not clean or discharge distributor outside the project limits of work.

### **3.2 DISTRIBUTOR**

- A. Bituminous distributor and equipment for heating bituminous material shall be designed, equipped, maintained, and operated so that bituminous material, at even heat, may be applied uniformly on variable widths of surface up to 15 feet at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.02 gallon per square yard. Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump, and a full circulation spray bar adjustable laterally and vertically.
- B. When applying tack and prime coats, take care to give the surface a very light, even application of asphalt.

### **3.3 PREPARATION OF SURFACE**

- A. Immediately before applying the tack or prime coat, remove loose material, dirt, clay or other objectionable material. Take particular care in cleaning the outer edges of the strip to be treated, to ensure that the prime or tack coat will adhere.
- B. Do not apply Prime Coat or Tack coat so far in advance that it might lose its adhesiveness as a result of being covered with dust or other foreign material.

### 3.4 APPLICATION

- A. Tack Coat: Apply tack coat uniformly at the rate of 0.10 gallon per square yard, at specified temperature. Apply within 24 hours preceding placement of the covering course.
- B. Tack coat of asphaltic emulsion shall be furnished and applied in conformance with the provisions in Section 94, State Standards Specifications and shall be applied to all vertical surfaces of existing pavement, curbs gutters and construction joints in the surfacing against which additional material is to be placed, and to other surfaces designated in the special provisions.

**END OF SECTION**

**SECTION 32 12 16**  
**ASPHALT CONCRETE PAVING**

**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- A. The work of this section consists of constructing one or more surface courses composed of a mixture of aggregate, filler if required, asphalt material and placed on a prepared base to lines, grades and details, as shown on the plans and covered within these specifications. This section includes asphalt patching for areas where utility lines cross existing paved surfaces, trench resurfacing, saw cutting and resurfacing additional paving widths as required in the contract or under permit requirements.
- B. Mix aggregate and asphalt binder at a central mixing plant. Haul, spread, and compact the mixture for paved areas as shown and as specified.
- C. Upon completion of all paving, finish the entire roadway. Trim and shape cut and fill slopes to produce smooth surfaces and uniform cross sections. Clean the finished pavement of all dirt and foreign material.
- D. Cross sections of paving shall be as indicated in the Plans.

**1.2 RELATED WORK**

- A. Section 31 23 00 – Earthwork
- B. Section 32 12 13 – Bituminous Prime and Tack Coat
- C. Section 32 12 36 – Seal Coat

**1.3 REFERENCES**

- A. Section 22 - Finishing Roadway, State Standard Specifications.
- B. Section 39 - Asphalt Concrete, State Standard Specifications.
- C. Section 92 - Asphalts, State Standard Specifications

**1.4 SUBMITTALS**

- A. As specified in the Standard General Conditions and Section 01 33 00 – Submittal Procedures.

B. Certificates:

1. Certification from the supplier that the asphalt concrete is of correct type and meets requirements of this section.
2. Job mix formula shall be submitted with certification that the mix formula meets the requirements of Section 39 – Asphalt Concrete, Standard Specification Specifications. The job mix formula shall include definite single values for:
  - a. The percent of aggregate passing the specified sieve, based on dry weight of aggregate.
  - b. The percent of bituminous material to be added, based on the total weight of the mix.
  - c. Kind and amount of chemical additives (anti-stripping, hydrated lime, etc.) as established by the design procedure.
  - d. Maximum theoretical density.
  - e. Temperature ranges for the bituminous material at the point of mixing with the aggregates and bituminous mixture at the paving machine.

1.5 *QUALITY ASSURANCE*

- A. Asphalt concrete supplier to prepare a mix design; to recommend adjustments to the proportions of the mix, as necessary, to conform to the mix design; and to consult with the Contractor and the Engineer during paving as required.
- B. Testing required to, determine compliance for the work of this section shall be performed by an independent testing laboratory, approved by the Engineer and appointed and paid for by the Contractor. The independent testing laboratory shall be used to sample and test asphalt concrete at the job sites. One test shall be taken for each paving period and at least one test every four hours. As a minimum, results of the test shall include items A, B, C and E of the job mix formula submittal.
- C. Density: Acceptable density of the in-place asphalt concrete pavement shall be 95 percent of the optimum values as determined from the mix design formula. Field sampling and density determination shall be made in accordance with AASHTO T230-68, or an accepted nuclear procedure.
- D. Testing shall be performed in such a manner that will least encumber the performance of the work. The Contractor shall cooperate by rerouting equipment or by temporarily closing the immediate work area to be tested.

- E. Contractor shall instruct the testing laboratory to provide the test results to the Engineer immediately in the field and a copy of the written report sent directly to the Engineer.

## **PART 2 PRODUCTS**

### **2.1 ASPHALTS**

- A. Asphalt binder to be mixed with aggregate shall be liquid asphalt PG 64-10, conforming to Section 92, "Asphalts", State Standard Specifications.

### **2.2 AGGREGATE**

- A. The combined aggregate grading of the asphalt concrete shall be Type B, 1/2-inch maximum, medium grading, per Section 39-2.02, State Standard Specifications.

### **2.3 FORMS**

- A. Redwood header boards shall be 2 inches wide by 6 inches deep (nominal measurement).
- B. Metal forms shall be submitted to Engineer for approval prior to use.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. The pavement section shall comply with County of Tulare Standards and as shown on the Plans.
- B. Prior to any paving and surfacing operations, all pipes and conduits shall be installed and properly backfilled as shown.

### **3.2 STORAGE**

- A. Storage of materials shall conform to Sections 39-3.01 through 39-3.01C, State Standard Specifications.

### **3.3 MIXING**

- A. Mixing shall conform to the approved mix design.
- B. The weight of asphalt binder to be mixed with aggregate shall be between 3 percent and 7 percent of the weight of the dry aggregate.

### **3.4 SUBGRADE**

- A. Subgrade shall conform to Section 39-4.01, State Standard Specifications.



- B. Unless otherwise specified, the upper 6" of subgrade beneath the structural section shall be scarified, moisture conditioned as necessary and compacted to at least 95 percent relative density.

### 3.5 *EQUIPMENT*

- A. Spreading and compacting equipment shall conform to Section 39-5, State Standard Specifications.

### 3.6 *SPREADING AND COMPACTING*

- A. Spreading and compacting shall conform to Section 39-6, State Standard Specifications.
- B. Apply mixture only during hours of daylight; when air temperature is 50 degrees F or higher; when surfaces to be paved are dry and free of frost, snow or ice; and when precipitation is not imminent.

### 3.7 *FORMS*

- A. Wood or metal. Place true to line and grade, and anchor securely. Use adequately sized forms or prevent bulging and bending while the bituminous surface is being worked.

### 3.8 *COLD PLANE ASPHALT CONCRETE PAVEMENT*

- A. Existing asphalt concrete shall be cold planed at the locations and to the dimensions shown on the plans and in accordance with these special provisions.
- B. The depth, width and shape of the cut shall be as indicated on the typical cross sections or as directed by the Engineer. The final cut shall result in a uniform surface conforming to the typical cross sections. The road surfacing to remain in place shall not be damaged in any way.
- C. The depth shown on the plans for cold plane wedge cuts along existing concrete gutter are to be measured from the surface of the concrete gutter. In some cases where a prior overlay surface was constructed above the gutter lip, the actual depth of cut will exceed the dimension shown on the plans.
  - 1. The Contractor shall remove existing pavement overlay from the top surface of gutters adjacent to any area specified to be cold planed.
- D. The planing machine shall be self-propelled and especially designed and built for grinding flexible pavements. It shall plane without tearing or gouging the underlying surface and blade material in a windrow. Drum lacing patterns shall permit a grooved or smooth surface finish as selected by the Engineer and the drum shall be totally enclosed in a shroud to prevent discharge of any loosened material into adjacent work areas. A zero (0) inches to three (3) inches deep cut to predetermined grade may be required on one (1) pass. The machine shall be

adjustable as to crown and depth. The equipment shall meet the standards set by the Air Quality Act of 1969 for noise and air pollution.

- E. The Contractor shall provide a smaller machine to trim areas inaccessible to the larger machine at manholes, curb returns and intersections. The smaller machine shall be equipped with a twelve (12) inches wide cutting drum mounted on a three (3) wheel chassis allowing it to be positioned without interrupting traffic or pedestrian flow. Jack hammering areas not accessible to grinding machine is not allowed.
- F. The surface tolerance produced shall be such that a ten-foot straight edge laid laterally will indicate variances of less than three-eighths (3/8) inch. The Contractor shall remove all loosened material from the roadway each day before leaving the site of the work.
- G. The Contractor shall protect structures and provide necessary traffic control and barricades as required by the Engineer.
- H. Temporary oil-sand ramps shall be constructed at intersecting streets, and along longitudinal joints, immediately after cold planing and prior to opening the lanes to traffic. Cold planing operations shall not commence until temporary oil-sand is on site with workers to place material.
- I. Cold planing cuts across travel lanes shall be the last cuts made at each side. After removal of loosened material from such cuts, temporary ramps shall be constructed of oil-sand at the deep end of cuts before opening the lane to traffic.
- J. Irregular, gouged, ripped or damaged areas, as determined by the Engineer, shall not be accepted. All such areas shall be repaired by methods approved by the Engineer, prior to resurfacing operations. The Engineer, at his discretion, may require substitution of planing machine and/or operating personnel if the cold-planed surface does not meet these specifications.
- K. Existing traffic detector loops damaged during cold plane operations will be returned to their original condition.
- L. After conducting cold planing operations on a given street, the Contractor shall begin pavement operations on that street within seven (7) calendar days. Deviations from this requirement must be requested in writing and approved by the Engineer prior to the beginning of planing operations.

### 3.9 MISCELLANEOUS AREAS

- A. Paving miscellaneous areas shall conform to Section 39-7.01, State Standard Specifications.

### 3.10 FINISHING PAVED AREAS

- A. Finishing roadway and parking areas shall conform to the provisions of Section 22, State Standard Specifications.

### 3.11 TRENCH RESURFACING

- A. At areas where asphalt concrete had been removed due to pipeline construction, trench shall be resurfaced in accordance with the details shown on the Plans.
- B. If during the Contractor's operations pavement is disturbed outside the limits of removal, Contractor shall make the necessary repairs at no additional cost to the Owner.

### 3.12 ACCEPTANCE REQUIREMENTS

- A. Surface Tolerance: The variation between any two contacts with the surface shall not exceed 0.015 foot in 10 feet. Correct all humps or depressions exceeding the specified tolerance by removing defective work and replacing it with new material at no additional expense to the Owner.
- B. A uniform compacted thickness shall be obtained for each course equal to or greater than the thickness shown. Individual tests shall not vary by more than plus or minus 0.02 foot.
- C. Width: Plan dimension, plus or minus 0.02 foot.
- D. Thickness: Plan dimension, plus or minus 0.02 foot.

**END OF SECTION**

## **SECTION 32 12 36**

### **SEAL COAT**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. Furnish and apply a fog seal coat (asphalt emulsion without screenings) to asphalt concrete paving, including roadway, parking lots and driveway areas.

##### **1.2 RELATED WORK**

- A. Section 32 12 13 – Bituminous Prime and Tack Coat
- B. Section 32 12 16 – Asphaltic Concrete Paving

##### **1.3 REFERENCES**

- A. Section 37 – Bituminous Seals, State Standard Specifications.
- B. Section 94 – Asphaltic Emulsions, State Standard Specifications.

##### **1.4 SUBMITTALS**

- A. Submittals shall be in accordance with the General Conditions and Section 01 33 00 – Submittal Procedures.
- B. The Contractor shall submit a certified copy of tests representing any shipment.
- C. A Certificate of Compliance shall accompany each shipment of asphalt to the work.
- D. The certificate shall include the shipment number, type of material, refinery, consignee, destination, quantity, contract or purchase order number, and date of shipment. The certificate shall state that the material complies with this section and shall be signed by the vendor or its representative.

##### **1.5 PROJECT CONDITIONS**

- A. Apply bituminous material only during daylight hours, when surface is dry, air temperature is above 65 degrees F, the surface temperature is 80 degrees or above, and weather is not foggy or rainy.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Asphaltic Emulsion shall conform to Section 94 of the State Standard Specifications
  - 1. Asphaltic Emulsion shall be polymer modified, rapid setting and shall be anionic (PMRS2h) or cationic (PMCRS2h) in accordance with the type of aggregate to be used.

## **PART 3 EXECUTION**

### **3.1 MAINTAINING TRAFFIC**

- A. At locations where public traffic is being routed over a surface upon which a seal coat is to be applied, the seal coat shall not be applied to more than one-half the width of the traveled way at a time, and the remaining width shall be kept free of obstructions and open for use by public traffic until the seal coat applied is ready for use by traffic.
- B. Provide for the passage of public traffic through the work and when applicable or required, route traffic through the work under one-way control.

### **3.2 APPLICATION**

- A. Apply the fog seal coat in accordance with Section 37, “Bituminous Seals”, State Standard Specifications.
- B. Seal coat shall consist of a fog seal applied to all asphalt concrete surfaces, including existing pavement, new pavement, overlays, and dikes in accordance with Section 37-1, “Bituminous Seals”, of the State Standard Specifications and the following provisions:
  - 1. Seal coat shall be applied five days after the completion of all asphalt concrete pavement construction, overlays, and dike construction and after all surfaces have been cleaned of loose material.
  - 2. Material shall be “Topein C” rejuvenator and sealant or approved equivalent and shall be applied at the rate of 0.10 gallons per square yard or as directed by the Engineer.

### **3.3 SURFACE PREPARATION**

- A. Immediately before application of seal coat, clean surface with a power or hand broom. Do not begin seal coating operation until the surface is approved by Contracting Officer.

### 3.4 APPLICATION

- A. Asphaltic Emulsion: Apply uniformly at the approximate rate of between 0.28 to 0.4 gallons per square yard at the specified temperature. The actual application rate will be determined in the field by the Contracting Officer. If the texture of the surface is such that asphaltic emulsion penetrates too rapidly, a preliminary application of from 0.05 to 0.10 gallon per square yard of surface may be required.
1. Use approved devices to insure that the beginning and end of the asphaltic emulsion covered areas are positive and clean.
  2. The distributor shall be moving forward at proper application speed at the time the spray bar is opened. Correct any skipped areas or deficiencies. Make junctions of spreads carefully to ensure a smooth riding surface.
  3. Do not spread asphaltic emulsion in excess of the length that can be immediately covered with aggregate.
  4. When operating under part-width construction, leave a strip of bituminous material, approximately 6 inches wide, uncovered to permit a slight overlap of the bituminous material.

**END OF SECTION**

## **SECTION 32 31 00**

### **FENCING**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. Provide all labor, materials and equipment and perform all operations necessary to complete to install chain link fencing as specified, shown on the Drawings, or as directed.

##### **1.2 RELATED WORK**

- A. Section 03 33 01 – Cast-in-Place Concrete (site work)
- B. Section 31 23 00 – Earthwork

##### **1.3 REFERENCES**

- A. Section 80 – Fences, State Standard Specifications

##### **1.4 SUBMITTALS**

- A. As specified in Section 01 33 00 – Submittal Procedures

#### **PART 2 PRODUCTS**

- A. Chain Link shall conform to State Standard Specifications Section 80-3.02
- B. Fence lines adjacent to residences shall be furnished with brown ultraviolet resistant PVC privacy slats conforming with State Standard Specifications Section 80-3.02E.
- C. Right of Way fence shall conform to State Standard Specifications Section 80-3.

#### **PART 3 EXECUTION**

##### **3.1 FENCES AND GATES**

- A. Installation shall be in accordance with State Standard Specifications, Section 80, and with State Standard Plans Drawing A85, A85A and as indicated on the Plans.
- B. Relocation and installation of other fencing materials shall be in accordance with the plans and standard construction practices.

3.2 *GATES*

- A. Gates shall conform with the requirements of State Standard Specifications Section 80-10, Gates.
- B. Existing gates shall be relocated as shown on the Plans.

**END OF SECTION**



## SECTION 32 31 13

### CHAIN LINK FENCES AND GATES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Chain-link fences.
  - 2. Swing gates.
- B. Related Sections:
  - 1. Division 03 Section "Cast-in-Place Concrete".
  - 2. Division 03 Section "Post Installed Concrete Anchors".

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, gate hardware, and finishes for chain-link fences and gates.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show accessories, hardware, gate operation, and operational clearances.

##### 1.4 QUALITY ASSURANCE

- A. Accessible Gates: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines, ICC/ANSI A117.1, and the California Building Code.

##### 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

## PART 2 - PRODUCTS

### 2.1 CHAIN-LINK FENCE FABRIC

- A. General: Provide chain link fence fabric in one-piece heights, measured between top and bottom of outer edge of selvage knuckle or twist. Comply with CLFMI Product Manual and with requirements indicated below:
1. Fabric Height: As indicated on Drawings.
  2. Wire diameter: 0.148 inches (9 gage).
  3. Mesh Size: 2 inches.
  4. Zinc-Coating: ASTM A 392, Type II, Class 1, 1.2 oz./sq. ft. with zinc coating applied after weaving.
  5. Selvage: Knuckled at both selvages.

### 2.2 FENCE FRAMING

- A. Posts and Rails: Comply with ASTM F 1043 for framing, including rails, braces, and line; terminal; and corner posts. Heavy industrial strength round steel pipe, material Group IA, schedule 40, galvanized; pipe coated inside and outside by hot-dipped method, 1.8 oz. per square foot of surface; provide members with minimum dimensions and wall thickness according to ASTM F 1083 based on the following:
1. Fence Height: As indicated on Drawings.
  2. Gate Posts: Posts for individual gate leaf widths as follows:
    - a. Gate leaf width to 6 feet: 2.875 inches outside diameter, 5.79 plf.
    - b. Gate leaf width over 6 feet to 12 feet: 4.0 inch outside diameter, 9.11 plf.
  3. Horizontal and Brace Rails: 1.66 inches outside diameter, 2.27 plf.

### 2.3 TENSION WIRE

- A. Tension Wire: 0.177-inch diameter, marcelled steel tension wire complying with ASTM A 817 and ASTM A 824; Type II, zinc coated (galvanized), Class 4, not less than 1.2 oz./sq. ft. of uncoated wire surface.

## 2.4 SWING GATES

- A. General: Comply with ASTM F 900 for gate posts and swing gate types.
1. Gate Height: Match fence height.
  2. Gate Leaf Width: As indicated on Drawings.
    - a. Pedestrian gates shall provide not less than 32 inches in clear width with the gate in a 90 degree open position.
- B. Gate Framing: Steel pipe matching fence framing and as follows:
1. Gate leaf width up to 6 feet, perimeter framing: 1.90 inches outside diameter, 2.72 plf.
  2. Gate leaf width over 6 feet to 12 feet, perimeter framing: 2.375 inches outside diameter, 3.65 plf.
  3. Intermediate Framing and Bracing: 1.90 inches outside diameter, 2.72 plf.
- C. Gate Construction:
1. Corner Construction: Assemble gates with corner fittings.
  2. Bracing: Provide adjustable truss rod bracing for all gates and between intermediate framing members for gate leaves over 8 feet in width.
  3. Intermediate Framing: Provide intermediate vertical framing for gates exceeding 8 feet in width; equally space intermediate framing and space not more than 8 feet on center.
- D. Gate Hardware:
1. Hinges: 180-degree swing in direction indicated on Drawings.
  2. Latches permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
    - a. Lever handle operating hardware: Gates 4 feet in width or less shall have lever handled hardware that does not require pinching, grasping, or twisting to operate.
  3. Double Gates: The inactive leaf of double gates shall be provided with a drop rod and be capable of being locked with a padlock.
  4. Gate Stops: Provide gates stops for each leaf of double gates.
  5. Gate Keepers: Provide gate keepers for each gate leaf 5 feet or more in width.

## 2.5 FITTINGS

- A. Fittings, General: Comply with ASTM F 626.
- B. Post Caps: Caps shall be weatherproof to prevent moisture intrusion into posts. Provide line post caps with loop to receive top rail; provide for each post.

- C. Rail and Brace Ends: Designed to provide secure connection of top rails to terminal post and brace or other rails to terminal and intermediate posts; provide for each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
  - 1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.
  - 2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate rails in the fence line-to-line posts.
- E. Tension and Brace Bands: Pressed steel for posts up to 4 inches in outside diameter.
- F. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.
- G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment; minimum 5/16 inch rod diameter.
- H. Tie-Wire: Standard round wire ties for attaching chain-link fabric to posts, rails, and frames; hot-dip galvanized steel, 0.148-inch (9 gage) diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.
- I. Hog Rings: Round wire ties for attaching chain-link fabric to bottom tension wire; 0.12-inch diameter of same material and finish as fabric wire.
- J. Finish: Metallic coating for pressed steel or cast iron fittings, not less than 1.2 oz. /sq. ft. zinc.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements indicated.

### 3.2 FENCE FRAMING INSTALLATION

- A. Post Setting: Posts shall be welded to base plate and set to concrete with Post Installed Concrete Anchors.
  - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with mechanical devices.
- B. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing.

- C. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- D. Intermediate and Bottom Rails: Where indicated or required, install and secure to posts with fittings.
- E. Bottom Tension Wire: Install according to ASTM F 567 extended along and within 6 inches of bottom of fabric maintaining plumb position and alignment of fencing. Pull wire taut, without sags; install tension wire before stretching fabric; tie to each post with not less than same diameter and type of wire.

### 3.3 CHAIN-LINK FABRIC INSTALLATION

- A. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2 inches between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- B. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches o.c.
- C. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing. Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.
- D. Fasten fabric to tension wire with hog rings spaced a maximum of 24 inches o.c.
- E. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

### 3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

### 3.5 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or

malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

- B. Lubricate hardware and other moving parts.

END OF SECTION

**SECTION 33 05 26**  
**UTILITY LINE MARKING**

**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- A. The work of this section consists of furnishing and installing utility line marking.

**1.2 SUBMITTALS**

- A. Submittals shall be in accordance with the General Conditions and Section 01 33 00 – Submittal Procedures.
- B. Samples: 24-inch strips of tape.
- C. Certification that the materials used in the tape fabrication meet the requirements of this section.

**PART 2 PRODUCTS**

**2.1 MARKING TAPE**

- A. Capable of being inductively detected electronically.
- B. Construction: Metallic foil laminated between two layers of impervious plastic film not less than 3 inches wide. Total thickness of tape shall not be less than 0.005 inch (5 mil) plus or minus 10 percent manufacturing tolerances.
  - 1. Film: Inert plastic. Each film layer shall be not less than 0.001 inch thick (1.0 mil).
  - 2. Foil: Not less than 0.001 inch thick (1.0 mil).
  - 3. Adhesive: Compatible with foil and film.
- C. Imprint: 3/4-inch or larger bold black letters.
- D. Legend: Identify buried utility line tape with imprint such as "Caution: Water Line Below". Repeat identification at approximately 24 inch intervals.
- E. Background Color: APWA color code and as specified below:

Color	Utility
Safety Precaution Blue	Water System, Irrigation

- F. Manufacturer: Lineguard, Inc., Wheaton, Illinois; Reef Industries, Inc., Houston, Texas; Thor Enterprises, Inc., Sun Prairie, Wisconsin; or Engineer approved equivalent.

## 2.2 *TRACER WIRE*

- A. Minimum: No.10, solid copper wire with Type TW insulation, and shall form a mechanically and electrically continuous line throughout the length of the pipe.

## **PART 3 EXECUTION**

### 3.1 *MARKING TAPE*

- A. Install tape in backfill directly over each buried utility line as shown on the detailed drawings. Tape should be installed approximately 24” above top of pipe.
- B. Where utilities are buried in a common trench, identify each line by a separate warning tape. Bury tapes side by side directly over the applicable line.

### 3.2 *TRACER WIRE*

- A. Wherever PVC or Polyethylene pipe is installed in the ground, a tracer wire shall be installed.
  - 1. Tracer wire shall be brought to the surface at all valves, air valves, blow-offs, Fire Hydrants Water Services and other pipeline appurtenances
- B. Tracer Wire: Attachment of the wire to the pipe shall be made with plastic tie-wraps or other approved method.
- C. Contractor shall conduct a satisfactory continuity test prior to Owner acceptance.

**END OF SECTION**



## **SECTION 33 13 00**

### **DISINFECTION OF WATER DISTRIBUTION SYSTEM**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. Disinfection of all new potable piping, components, and appurtenances.
- B. This shall include disinfection of all potable water piping, well, hydropneumatic tank, finished water storage tank, and pumps.
- C. New facilities shall be kept isolated from the active distribution system using a backflow, double check valve device per ANSI/AWWA C651 - Disinfecting Water Mains.
- D. Before allowing water from the municipal supply system to enter the new potable water system, all its components shall be cleaned and disinfected.
- E. Test and report results. Cost of all testing shall be borne by the Contractor.
- F. Connect new system and existing water distribution mains, after all required test are satisfactory and approved by the Engineer.

##### **1.2 RELATED WORK**

- A. Section 33 01 00 – Pipe and Fittings

##### **1.3 REFERENCE**

- A. ANSI/AWWA C651 – Disinfecting Water Mains.
- B. ANSI/AWWA C652 – Disinfection of Water Storage Facilities
- C. ANSI/AWWA C654 – Disinfection of Wells

##### **1.4 SUBMITTALS**

- A. Submit five copies of Contractor-prepared water system disinfection plan. Plan shall include the following information:
  - 1. Sequence and schedule for flushing and disinfection work.
  - 2. Materials to be used for disinfection.
  - 3. Method of chlorination.

4. The overall order of all disinfection activities.
  5. Description of sequence for disinfection of distribution system.
  6. Description of sequence for disinfection of all components of the water distribution system, including how Contractor will isolate segments of the water system for disinfection.
  7. Description and location of bacteriological sample points throughout the system to confirm successful disinfection of entire water system. Sample point spacing not to exceed 1,200 feet per AWWA Standard C651.
  8. Description of materials and procedure to dechlorinate chlorinated water.
  9. Description of how and where flushing and dechlorinated water will be disposed of.
- B. Submit five copies of each compliance report to Engineer. Reports shall include the following information:
1. Disinfection report; accurately record:
    - a. Type and form of disinfectant used.
    - b. Date and time of disinfectant injection start and time of completion.
    - c. Test locations.
    - d. Initial and 24-hour disinfectant residuals in parts per million (ppm) for each location tested.
    - e. Date and time of flushing start and completion.
    - f. Disinfectant residual after flushing in ppm for each location tested.
    - g. Persons present during the disinfection operation.
  2. Bacteriological report; accurately record:
    - a. Date issued, project name, and testing laboratory name, address, and telephone number.
    - b. Time and date of water sample collection.
    - c. Name of person collecting samples.
    - d. Test locations.

- e. Initial and 24-hour disinfectant residuals in ppm for each location tested.
  - f. Coliform bacteria test results for each location tested.
  - g. Certification that water conforms, or fails to conform, to bacterial standards of the California State Water Resources Control Board.
  - h. Bacteriologist's signature.
- C. Submittals shall be in accordance with the General Provisions.

### 1.5 QUALITY ASSURANCE

- A. Testing laboratory certified with the State of California for examination of drinking water.
- 1. Testing laboratory shall be selected by the Contractor and approved by the Owner.
  - 2. All samples shall be gathered and tested by said Laboratory.
  - 3. Contractor shall instruct the testing laboratory to provide the test results to the Engineer immediately upon results and a copy of the written report sent directly to the Engineer.

## PART 2 PRODUCTS

### 2.1 CHLORINE

- A. All disinfectant chemicals shall be certified to ANSI/NSF Standard 60
- B. Chlorine-bearing compounds:
- 1. Calcium hypochlorite (comparable to commercial products known for example as HTH, Perchloron, and Pittchlor, sold for swimming pool chlorination).
  - 2. Sodium hypochlorite (liquid bleach, sodium hypochlorite in powder or tablet form for pool chlorination).

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Verify that system has been cleaned, inspected, and pressure tested.

- B. If a chlorine-bearing compound is to be used, the calcium hypochlorite or sodium hypochlorite shall be prepared as a water mixture before introduction into the potable water piping system. The powder shall first be made into a paste and then thinned to approximately a 1- percent chlorine solution (10,000 ppm). The preparation of 1- percent chlorine stock solution requires the following proportions of powder to water:

<u>Product</u>	<u>Amount of Compound</u>	<u>Quantity of Water (Gals)</u>
High-test Calcium Hypochlorite (65 to 70 percent Cl)	1 lb.	7.50
Sodium Hypochlorite liquid (5.25 percent Cl)	1 gal.	4.25

### 3.2 APPLICATION

- A. Contractor shall coordinate activities with County of Fresno Operations Supervisor or the System Operator and shall provide and attach equipment required to execute work of this Section. This may include:
1. A solution-feed chlorination device.
  2. A device to regulate rate of flow and provide effective diffusion of the gas into the water within the pipe being tested. Chlorinating devices for feeding solutions of the chlorine gas or the gas itself into the water shall provide means for preventing the backflow of water into the chlorine cylinder.
- B. Preliminary Flushing: Before disinfection, the system with outlets open shall be flushed thoroughly with water. Flushing shall be done after the pressure test has been made. Flushing shall develop a velocity in pipes of at least 2.5 feet per second (fps).
- C. Point of Application: The preferred point of application of the chlorinating agent is at the beginning of the pipeline extension of any valved section, and through a corporation stop inserted by the Contractor (except in new distribution systems) in the top of the newly laid pipe. The water injector for delivering the chlorine-bearing water into the pipe shall be supplied from a tap on the pressure side of the gate valve controlling the flow into the pipeline extension.
- D. Retention Period: Treated water shall be retained for at least 24 hours.
- E. Chlorinating Valves and Hydrants: In the process of chlorinating newly laid pipe, all valves or other appurtenances shall be operated while the pipeline is filled with the chlorinating agent.

- F. Circulate and flush repeatedly until specified cleanliness is achieved. Before being placed in service, all new mains and repaired portions of, or extensions to, existing mains shall be chlorinated so that a chlorine residual of not less than 25 mg/l free available chlorine remains in the water after 24 hours standing in the pipe.

### 3.3 TESTS

- A. Samples shall be tested in accordance with ANSI/AWWA C651, C652, and C654.
  - 1. If disinfection fails to produce satisfactory test results, the new pipes and facilities may be re-flushed and retested. If samples taken after re-flushing also fail to produce satisfactory results, sections represented by those results shall again be disinfected and retested. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project.

**END OF SECTION**

## **SECTION 33 29 00**

### **ABANDONMENT OF EXISTING WELL**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. The work consists of destroying one (1) existing well in El Porvenir and destroying one (1) existing well in Cantua Creek.
- B. The work on the well will consist initially of sounding the bottom of each well in Cantua Creek and bailing and/or blowing out any apparent fill (total depth of 1,518 feet in El Porvenir and total depth of 830 feet in Cantua Creek). The well will then be video logged. If, upon review of the video logs, any undesirable materials, including obstructions to filling and sealing, debris, oil from oil-lubricated pumps, or pollutants and contaminants that could interfere with well destruction are found in the well, the work will include cleaning all such material out of the wells.
- C. After the wells are sufficiently cleaned out the work will consist of destroying the well by puncturing the lower portion of the wells and filling completely with sand-cement grout.
- D. The purpose of destroying the well is to assure that the wells do not act as conduits for poor quality groundwater to contaminate deeper, higher quality groundwater.

##### **1.2 RELATED WORK**

- A. Section 31 23 00 – Earthwork
- B. Section 33 13 00 – Disinfection of Potable Water Supply
- C. Section 26 26 50 – Electrical

##### **1.3 STANDARDS AND PERMITS**

- A. The wells shall be destroyed in accordance with the Fresno County Water Well Ordinance, the California Water Well Standards, and as described in these Specifications.
- B. The Contractor shall obtain, and pay for if necessary, a permit from Fresno County for each well.

##### **1.4 EXPERIENCE AND LICENSE**

- A. Well driller shall possess a C-57 Contractor's License, valid in the State of California.

1.5 1.5 *ORDER OF WORK*

- A. The Contractor shall schedule delivery of equipment and materials to destroy the existing well. The existing well shall be completely destroyed as specified in Section 01 11 00.

1.6 *WORK TO BE PERFORMED BY THE CONTRACTOR*

- A. The Contractor shall perform all work necessary to destroy the existing well, and all other work incidental to this task. The Contractor shall provide all necessary equipment.
- B. The Contractor will prepare and maintain access to the work area as well as provide sufficient room for the efficient operation of his equipment. Contractor shall provide temporary fencing to enclose the work area and all stored equipment. The Contractor will be held as having examined the work site and access roads in order to acquaint himself with local conditions, as no allowance will be made after the bid has been accepted for any errors or omissions made by the Contractor due to site conditions.
- C. The Contractor shall diligently pursue all work to completion. Upon completion of the work, the Contractor shall level the site, and remove all materials incidental to the operations.
- D. The entire cost of furnishing, transporting, unloading, hauling, handling, sorting, and caring for all equipment, materials, tools, and supplies, and of removing same from the site of the work as hereinafter specified, shall be included in prices bid in the proposal for the work for which the materials are required. The work shall be done with equipment of proper type and size and in good working condition so that the work can be performed without interruption arising from defective or improper equipment. All materials that will become a part of the completed work shall be new. All equipment, materials, tools, and supplies not a part of the destroyed well shall remain the property of the Contractor and shall be removed from the site upon completion of the work. All materials to be stored shall be stored at the site within a fenced enclosure.

1.7 *SECURITY*

- A. The actual work area shall be fenced with a temporary 6-foot-high chain link fence during construction operations. The fence shall be constructed and maintained in good condition throughout the course of the work so as to exclude unauthorized persons and animals from the site. The fenced area shall be posted with “NO TRESPASSING” signs visible from all angles of approach.
- B. The Contractor shall provide, at all times during the duration of the Contract, suitable means of protecting the well casing from the entrance of foreign objects.

### 1.8 NOTIFICATION

- A. The Contractor shall give notice to the Engineer of specific operations as follows:
  - 1. At least twenty-four (24) hours advance notice of video logging.
  - 2. At least twenty-four (24) hours advance notice of filling the well with sand-cement grout.

## PART 2 PRODUCTS

### 2.1 SAND CEMENT GROUT

- A. Sand cement grout shall be composed of not more than two parts by weight of sand and one part of Portland Type II cement t
- B. There shall be 4.5 to 6.5 gallons of clean water per sack of cement.

## PART 3 EXECUTION

### 3.1 HOURS OF OPERATION

- A. Operations may proceed between the hours of 7am and 7pm. When work is expected to occur outside the above hours the Contractor shall notify all residents within 500 feet of the impending construction activity.

### 3.2 INITIAL CLEANOUT OF WELL

- A. The well shall initially be sounded to measure the total depth of each well and the presence of any fill. If any fill is found in the well, the wells shall be bailed and/or blown out to remove all fill as practicable.

### 3.3 VIDEO SURVEY

- A. A color video survey of the entire length of the casing shall be performed to determine the presence of any undesirable materials, including obstructions to filling and sealing, debris, oil from oil-lubricated pumps, or pollutants and contaminants that could interfere with well destruction.
- B. The video log is also to determine if the perforations are open.
- C. The video survey equipment shall have side scan capability. The video log shall be submitted to Engineer for review prior to further activities.

### 3.4 FINAL CLEANOUT OF WELL

- A. Following review of the video survey, the Contractor shall clean out all undesirable materials that could interfere with each well destruction.



### 3.5 WELL DESTRUCTION

- A. In El Porvenir the casing shall be punctured from a depth of 830 feet to the bottom of the well, a depth of 650 feet. In Cantua Creek the casing shall be punctured from a depth of 505 to the bottom of the well, a depth of approximately 325 feet. The bottom of each casing shall also be drilled out. Each casing should be adequately opened to allow the gravel envelope to enter the well casing. The gravel will then be blown and/or bailed out of each well.
- B. A hole shall be excavated around each well casing to a depth of 5 feet below the ground surface and each well casing removed to the bottom of the excavation.
- C. Each well shall then be filled completely with sand-cement grout from bottom to top and in conformance with regulations of the Fresno County Water Well Ordinance. The grout shall be allowed to spill over into the excavation to form a cap. Each well casing shall be filled with water during placement of the grout seal. The cement grout shall be placed by pressure grouting with the use of a tremie pipe. Grout placement shall start with the tremie pipe at the bottom of the area to be grouted. The cement grout shall be placed through the tremie pipe, and the pipe shall be gradually withdrawn as the cement rises in the annulus. The quantity of cement grout placed in the annulus shall not be less than the computed volume of the annulus. A quantity less than the computed value will be judged as an indication of voids, and measures shall be taken by the Contractor to eliminate the apparent voids.
- D. After each well has been properly filled, including twenty-four (24) hours for the sealing material in the excavation to set, the excavation shall be filled with native soil.

**END OF SECTION**

## **SECTION 33 31 13**

### **GRAVITY SEWER PIPING AND APPURTENANCES**

#### **PART 1 GENERAL**

##### *1.1 WORK INCLUDED*

- A. The work of this section consists of furnishing and installing new gravity sewer piping and appurtenances and repairing and replacing existing gravity sewer piping.

##### *1.2 RELATED WORK*

- A. Section 03 30 00 – Cast-in-Place Concrete
- B. Section 31 23 17 – Trenching, Backfilling and Compaction
- C. Section 33 39 13 – Manholes
- D. Section 40 05 00 Pipe and Fittings

##### *1.3 REFERENCES*

- A. ASTM D3034 - Standard Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
- B. ASTM D1784 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
- C. ASTM D2412 Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
- D. ASTM F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- E. ASTM D3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- F. ASTM D2729 Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- G. ASTM D2949 Standard Specification for 3.25-in. Outside Diameter Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
- H. ASTM D2665 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
- I. ASTM C425 Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings

- J. ANSI/AWWA C150/A21.50-96, American National Standard for Thickness Design of Ductile-Iron Pipe
- K. ANSI/AWWA C151-A21.51, American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water
- L. ANSI/AWWA C104/A21.4, Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
- M. ANSI/AWWA C110/A21.10: Standard for Ductile-Iron and Gray-Iron Fittings
- N. ANSI/AWWA C153/A21.53-94, American National Standard for Ductile-Iron Compact Fittings
- O. ANSI/AWWA C111/A21.11-90, Standard for Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings

#### 1.4 *SUBMITTALS*

- A. Submittals shall be in accordance with the General Conditions and as specified in Section 01 33 00 – Submittals
- B. Manufacturer's literature and certificates of compliance with the reference standards for pipe, fittings, and couplings.
- C. Manufacturer's installation instructions or guide.
- D. Written procedure for cleaning sewer lines and disposing of fluidized materials removed.

#### 1.5 *CONTRACT CLOSEOUT*

- A. As specified in Section 01 70 00 – Contract Closeout.
- B. Contractor shall furnish as-built drawings for all underground sewer piping installed under this contract. Drawings shall be 11"X17" and 24"X36" paper copies plus one DVD containing pdf copies of the as-built drawings. Indicate station and depth of all crossed utilities or structures.

#### 1.6 *PRODUCT HANDLING*

- A. **Delivery:** Handle pipe carefully to ensure delivery at the project site in sound, undamaged condition. The Owner will reject damaged pipe or appurtenance on site. Contractor shall replace damaged pipe at no additional expense to the Owner.
- B. **Storage:** Do not store materials directly on the ground. Adequately support piping to prevent warpage. Use protective covers where pipe or appurtenances may be damaged by direct sunlight.

## **PART 2 PRODUCTS**

### **2.1 POLYVINYL CHLORIDE GRAVITY SEWER PIPE AND FITTINGS(PVC)**

- A. General: PVC pipe 4-inches and larger in diameter shall conform to ASTM D3034, SDR 35. Each length of pipe shall be marked with the manufacturers name, nominal size and ASTM designation. Pipe shall be made of PVC plastic having a cell classification of 12454B or 12364B as defined in ASTM D1784 and shall have SDR of 35 and minimum pipe stiffness of 46 PSI according to ASTM Test D2412.
- B. Joints: Pipe shall include an integral bell section with a factory assembled rubber ring gasket conforming to ASTM F477. Joint shall conform to ASTM D3212. Bells shall meet the same strength requirements as that of the pipe.
- C. Fittings: Fittings shall be supplied by the pipe manufacturer and shall meet the strength requirement of the pipe. Integral bells and gaskets shall conform to the requirements for joints in this section. Fittings shall be marked with nominal size, manufacturers name and ASTM designation.
- D. PVC sewer pipe small than 6 inches, for chemical drain shall conform to ASTM D2729 and D2949. Fittings shall be PVC with socket welded joints and shall conform to ASTM D2949 and ASTM D2665.

### **2.2 VITRIFIED CLAY PIPE AND FITTINGS (VCP)**

- A. Vitrified clay pipe (VCP) and fittings shall be new, first quality pipe and shall meet the requirements of ASTM C700 for Extra Strength VCP. Pipe and fittings shall be of the bell-and-spigot type with factory fabricated compression gasket. Gaskets and compression joints shall meet the requirements of ASTM C425.

### **2.3 DUCTILE IRON PIPE AND FITTINGS (DIP)**

- A. Ductile Iron pipe and fittings shall conform to AWWA C150/A21.50 and AWWA C151/A21.51. Pipe and fittings shall be polyethylene lined and seal coated in conformance to AWWA C104/A21.4. Thickness Class shall be Number 50 for pipe six (6) inches through thirty-six (36) inches and Number 51 for four (4) inch pipe (four inch pipe is for laterals only).
- B. All ductile iron pipe shall be polywrapped with black eight (8) mil thick polyethylene (see Section 2.11, "Protection from Corrosion"). If the pipe is cut to fit the required length, the exposed cut area of the pipe shall be coated with a minimum of one ( $\geq 1$ ) mil of bituminous material.
- C. The outside coating shall be a minimum of one ( $\geq 1$ ) mil of bituminous paint conforming to AWWA C151/A21.51. Prior to lining, the exterior and interior of the spigot end, including the spigot face, shall be coated with a minimum of eight ( $\geq 8$ ) mils of epoxy. Before lining the inside of the socket, including a portion of the gasket cavity and a portion of the pipe barrel, shall be coated with a minimum of eight ( $\geq 8$ ) mils of epoxy.

- D. Fittings shall be ductile iron, at least Class 54 thickness, and in conformance with AWWA C110/A21.10 or AWWA C153/A21.53 if compact fittings are to be used. Mechanical joints shall conform to AWWA C111/A21.11.

#### 2.4 FLEXIBLE COUPLINGS FOR GRAVITY PIPES

- A. Transition type couplings shall be factory manufactured to ensure watertight fit and smooth flow transition at the joint. Couplings shall be made of resilient elastomeric PVC, with all stainless-steel coupling bands including screw and housing. All materials shall be rustproof and unaffected by soil conditions or normal sewer gases, and shall be flexible with earth movement while maintaining seal. Poured concrete collar and similar coupling methods will not be accepted.

#### 2.5 SEWER CLEANOUTS

- A. Precast Concrete Valve Box
  - 1. Christy traffic valve box G8, with ring No. 2331 and lid No. C276, manufactured by Christy Concrete Products, Inc., Fremont, California, or approved equal.
- B. Risers
  - 1. Risers and plugs as required by applicable County standards.

### **PART 3 EXECUTION**

#### 3.1 GENERAL

- A. Construct the gravity sewer system, complete with appurtenances, to the lines and grades shown on the plans or established in the field.
- B. Plug pipes to be abandoned as specified in Sections 33 39 13 - Manholes.
- C. Sewers crossing water mains shall be laid to provide a vertical distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer line. The crossing shall be arranged so that the sewer joints are equidistant and as far as possible from the water main joints.
- D. Where a water main crosses under a sewer line, adequate structural support shall be provided for the sewer to prevent damage to the water main.
- E. Sewers shall be laid at least 10 feet horizontally from any existing or proposed water main. The distance shall be measured from outside edge to outside edge.

#### 3.2 PIPE

- A. Handling of Materials

1. Delivery: Handle pipe carefully to ensure delivery at the project site in sound, undamaged condition. Contractor shall replace damaged pipe at no additional expense to the Owner.
  2. Storage: Do not store materials directly on the ground. Adequately support piping to prevent warping. Use protective covers where pipe may be damaged by direct sunlight.
  3. No more than one week's supply of material shall be distributed in advance of pipe laying operations, unless otherwise approved or required.
  4. Before laying, pipe shall be inspected for cracked, broken, or defective pieces. Such pieces shall be rejected. Pipe shall be carefully lowered into the trench to prevent damage. All dirt or other foreign matter shall be removed from inside the pipe before lowering into the trench.
- B. Trenching and backfill shall conform to Section 31 23 17 - Trenching, Backfilling and Compacting or as shown on the plans.

### 3.3 *MANHOLES*

- A. Manholes shall be constructed as specified in Section 33 39 13 – Manholes.

### 3.4 *CLEANOUTS*

- A. Cleanouts shall be Constructed as specified in Section 33 39 13 - Manholes and as shown on the Plans.

### 3.5 *SEWER SERVICES*

- A. Sewer service laterals shall be installed in conformance with the project drawings.

### 3.6 *INSTALLATION OF NEW PIPE*

- A. Inspection: Inspect pipe for defects before lowering into the trench. Defective, damaged, or unsound pipe will be rejected.
- B. Laying: Properly prepare the trench bottom for pipe installation as specified and as shown on the Plans. Lay each length true to line and grade, to form smooth joint transitions and to prevent sudden offsets of the flow line. Use lasers when laying gravity sewer to grade.
- C. Cleaning: As work progresses, clear the sewer pipe interior of dirt and other debris by keeping swabs in the pipe and pulling them forward past each completed joint. Cleaning shall be in accordance with Section 33 03 30 - Sewer Line Cleaning.
- D. Pipe Cutting: Cutting for closure or other reasons shall be done neatly by methods recommended by the manufacturer. Sharp edges shall be smoothed to prevent gasket damage.

- E. Jointing: Clean gaskets and seats of foreign materials prior to joint assembly. Apply lubricant as recommended by the pipe manufacturer.
  - 1. Push-On Joint: Carefully insert the spigot end into the bell to prevent entry of dirt and incorrect entry angle. With suitable fork tool, crowbar, or by hand, make the joint to the insertion depth recommended by the manufacturer. When the selected pipe uses joints not designed for full depth insertion, prevent further closure of previously completed joints by restraining movement of the installed line while making succeeding joints.
  - 2. Mechanical Joint: Carefully center the spigot in the bell and position the gasket evenly in the seat. Tighten bolts alternately to an even torque, causing the follower gland to expand the gasket uniformly for a tight seal.
  - 3. Plain End Jointing: Couple plain ends of pipe with specified flexible coupling installed in accordance with the manufacturer's directions. Horizontal gap between pipes shall not exceed 1 inch at the joint when pipes having the same nominal size are coupled, and shall be the minimum permitted by the coupling installed for different nominal sizes of pipe. Scribe both ends of pipe to be joined to ensure coupling is located at center of joint. Tighten bolts or bands evenly. If other coupling systems are to be used, submit installation literature and follow manufacturer's guidelines for installation.

### 3.7 REPLACEMENT OF EXISTING PIPING

- A. Verification of location of existing piping to be removed and replaced is the responsibility of the Contractor. Remove and replace existing pipe with new pipe as shown on the plans.

### 3.8 SEWER LINE MARKING

- A. As specified in Section 33 05 26 - Utility Line Marking.

### 3.9 FINAL PIPE CLEANING

- A. Prior to testing, clean all lines to be tested by high-pressure water jet or mechanical means. Remove and dispose of fluidized material as approved by the Engineer. Cleaning shall be in accordance with Section 33 03 30 - Sewer Line Cleaning.

### 3.10 ACCEPTANCE TESTS AND INSPECTION FOR GRAVITY PIPING

- A. General
  - 1. All testing and inspection shall be performed after final backfill and compaction operations are complete. If the Contractor so desires, he may pretest the lines at his own expense, but final testing must be performed after compaction requirements have been approved.
  - 2. If any of the tests or inspections covered in this section indicates that sewers require repair, then after repairs are complete, all testing and inspection shall be performed again, at the Contractor's expense.

3. Prior to testing, all lines shall be thoroughly cleaned by flushing, and shall have passed a Wayne ball of appropriate size. Contractor is to submit to the Engineer a detailed procedure on protecting the existing sewer system from contaminants during the flushing operation.

B. Mandrel

1. All sections of completed gravity pipe main lines shall be tested to assure that no potential obstructions are present in the lines. A rigid mandrel with a circular cross section having a diameter not less than 95% of the specified pipe diameter shall pass through the pipe without resistance.

C. Low-Pressure Air Test

1. Supply air to the test section slowly. A constant pressure of 3.5 psig shall be reached and maintain internal pressure of at least 3.0 psig for at least five (5) minutes.
2. After the stabilization period, disconnect the air supply. A pressure loss of 0.5 psig is used to compute the allowable pressure loss using the following formula.
3. The minimum allowable time in minutes for such a pressure drop is determined from the formula  $T_{\min} = 0.000183D^2L$ , where:
  - a.  $D$  = Nominal inside diameter of pipe (inches)
  - b.  $L$  = Length of pipe test section (feet)
4. Regardless of the formula, the minimum time allowed for pressure drop shall be eight (8) minutes.
5. The pressure gage for monitoring the air pressure shall have a minimum division of .10 psi increments.
6. A valid test is when the air pressure is released from the opposite end of the inlet air entry connection with an air release apparatus outlet connection.
7. Adjustment of Pressure for Groundwater. Should the pipe section being tested lie below the local groundwater table, the test pressures shall be raised in proportion to the depth of the centerline of the pipe below the water table. Additional pressure (beyond the 3.5 psig specified above) shall be added at the rate of 0.433 psig per foot of depth below groundwater.

D. Video

1. Video inspection shall be performed on all new sewer mains. Video inspections shall be paid for by the Contractor and shall be completed prior to the final acceptance of the improvements.



2. The inspection shall be in color, and shall be recorded on DVD or external hard drive, which shall become the property of the Owner.
3. The Engineer shall be the sole judge as to the acceptability of construction revealed by such inspection.
4. Within 24 hours prior to testing, all lines shall be thoroughly flushed with water to assist camera in the identification of low areas.

**END SECTION**

## **SECTION 33 39 13**

### **MANHOLES**

#### **PART 1 GENERAL**

##### *1.1 WORK INCLUDED*

- A. The work of this section consists of furnishing and installing new sewer manholes and cleanouts as well as abandoning or removing existing gravity sewer system manholes.
  - 1. Connections to existing manholes.
  - 2. Manhole invert reconstruction.

##### *1.2 RELATED WORK*

- A. Section 02 41 00 – Demolition
- B. Section 03 33 01 – Cast-in-Place Concrete
- C. Section 31 23 17 – Trenching Backfilling and Compacting
- D. Section 33 31 13 – Gravity Sewer Pipe & Appurtenances

##### *1.3 SUBMITTALS*

- A. As specified in Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's literature for: manhole frame and cover, indicating all dimensions and details; precast concrete manhole sections and components, indicating all dimensions; PVC liner, ladder details; piping connection details, and joint sealing compound.

##### *1.4 PROJECT HANDLING*

- A. Handle manhole sections with care, using suitable lifting devices.

##### *1.5 REFERENCES*

- A. Section 12, Temporary Traffic Control, State Standard Specifications
- B. Section 15, Existing Facilities, State Standard Specifications
- C. Section 70, Miscellaneous Drainage Facilities, State Standard Specifications
- D. American Society for Testing and Materials (ASTM)

## **PART 2 PRODUCTS**

### **2.1 PRECAST CONCRETE MANHOLES**

- A. Precast circular concrete manholes shall comply with ASTM C478, except that the wall thickness shall be 5 inches minimum. Minimum manhole diameter shall be 48 inches. Design manholes for the depths shown in the drawings, assuming a soil density of 130 pounds per cubic foot.
- B. Minimum allowable steel shall be hoops of No. 4 wire cast into each unit.
- C. Precast top sections shall be concentric cone except where shown otherwise in the drawings.
- D. Design joints using a butyl rubber sealant per ASTM C990.

### **2.2 CONCRETE**

- A. Cast-in-place concrete shall be as specified in Section 03 33 00 – Cast-in-Place Concrete

### **2.3 STEPS**

- A. Cast manholes with steps (ladder rungs). Steps (ladder rungs) shall be 1/2-inch minimum diameter steel reinforced bar with a polypropylene plastic covering (per ASTM D4101). Minimum clear length of rungs shall be 14 inches. Space rungs vertically at 12 inches on center, set between 5 and 6 inches from the face of the concrete, and align with each other in a straight vertical line (both parallel and perpendicular to ladder rungs). Steps shall be Lane International P-14938 or equal.

### **2.4 FRAME AND COVER**

- A. Material: Gray cast iron, ASTM A48, Class 30 or ductile iron, ASTM A536, Grade 60-40-18 as manufactured by Neenah Foundry Company, Neenah, Wisconsin, or approved equal.
- B. Dimensions: Clear opening 24 inches, with base of frame designed to fit standard precast manhole cones and grade ring.
- C. Frame: Machined for self-sealing covers. Seat for the lid shall be a minimum of 7/8-inch wide. Frame shall have a minimum of four holes for expansion anchors.
- D. Cover: Cover type (solid, slotted, etc.) shall be as designated on the plans. Cover shall be marked with words, Sanitary Sewer in cast letters not less than 0.75 inches high.
- E. Frame and Cover. All frame and cover assemblies shall meet the requirements of ASHTO H-20, unless designated otherwise.

1. Cover Lift: Provide three cover lifts specifically designed to remove traffic weight lid.

F. The cover shall seat firmly into the frame without rocking. Frames and covers shall be matchmarked in sets before shipping to the site. Minimum weight of frames and covers shall be 280 pounds.

## 2.5 *PVC LINER*

A. Not used

## 2.6 *SEALING COMPOUND AND MORTAR*

A. Butyl rubber sealing compound shall comply with ASTM C990. Mortar shall comply with ASTM C387, Type S, or use grout complying with Section 03 30 00.

## 2.7 *GREASE INTERCEPTORS*

A. Not used

## 2.8 *GRAVITY SEWER PIPE*

A. As specified in Section 33 31 13 Gravity Sewer Piping & Appurtenances.

## 2.9 *STORM DRAIN PIPE*

A. Not used

## 2.10 *BACKFILL MATERIALS*

A. As specified in Section 31 23 00 – Earthwork.

## 2.11 *MANHOLE AND SEWER LINE SURFACE MARKERS*

A. As specified in Section 33 05 26 - Utility Line Marking

## 2.12 *PIPE CONNECTIONS FOR MANHOLES*

A. For precast manhole bases, provide resilient watertight connectors between the manhole and piping in accordance with ASTM C923. Connections shall consist of a chemically resistant neoprene EPDM flexible boot, locking ring, and pipe clamp(s). The locking ring shall be stainless steel and shall lock the boot into the preformed opening in the manhole. The pipe clamp shall be stainless steel.

B. For cast in place manhole bases, utilize the resilient water tight connection specified above without the locking ring or utilize a elastomeric plastic concrete manhole adaptor cast into the base.

- C. Pipe connections conforming to ASTM C923 shall be Kor-N-Seal (Dukor Corporation), Z-Lok-XP (A-Lok Products, Inc.), or equal. Concrete manhole adaptors shall be Fernco CMA or Large Diameter Waterstops or equal.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. Contractor shall maintain main line collection system flows. Acceptable methods for maintaining flow include: Bypass pumping, pumping to a truck, and a temporary bypass sewer line.
- B. Continue bypassing manhole until the new manhole is completed, or the existing manhole is rehabilitated.
- C. All lines used for bypassed flow must have the capacity to accept the bypass flow.
- D. All equipment used in the bypass operation shall be in good repair and adequate for the intended bypass service.

### **3.2 MANHOLE BASE**

- A. Excavate for the manhole and install a crushed rock base, 12 inches thick, per Section 31 23 17. Crushed rock base material shall extend 1 foot beyond the outside edge of the concrete manhole base. Compact to 90% relative density.
- B. Form and pour concrete bases as one monolithic pour. For sewer manholes, form the portion above the invert elevation of the sewer pipe to provide a smooth channel section. Channels shall vary uniformly in size and shape from inlet to outlet.

### **3.3 INSTALLING PRECAST MANHOLES**

- A. Set each precast concrete manhole unit plumb on a bed of sealant or mortar to make a watertight joint at least 1/2 inch thick with the concrete base or with the preceding unit. Point the inside joint and wipe off the excess sealant or mortar. Secure the manhole frame to the grade ring with grout and cement mortar fillet. Backfill, compact, and replace pavement.
- B. Assemble units so that the cover conforms to the elevation determined by the manhole location as follows:
  - 1. In Paved Areas: Top of cover shall be flush with the paving surface.
  - 2. In Shoulder Areas: Top of cover shall be flush with existing surface where it is in traveled way of shoulder and 0.1 foot above existing surface where outside limits of traveled way but not in the existing roadside ditch.
  - 3. In Roadside Ditch or Unpaved Open Areas: Top of cover shall be 18 inches above the ground surface.

### 3.4 *MANHOLE CONSTRUCTION*

- A. Sanitary sewer manholes shall be constructed in accordance with details shown on the Plans and in accordance with this Section.
- B. All pipes in sanitary sewer manholes shall be fitted with elastomeric ring type water seals at the manhole connection.

### 3.5 *SEALING AND GROUTING OF PRECAST MANHOLE SECTIONS*

- A. Clean ends of precast sections of foreign materials. Place two wraps of butyl rubber sealing compound around the groove of the lower section. Set next section in place. Fill remaining interior and exterior joint cavity completely with mortar of the proper consistency. Trowel interior and exterior surfaces smooth on tongue-and-groove joints. Wipe off any excess grout from the interior and exterior of the joints. Prevent mortar from drying out by applying curing compound or comparable method. Chip out and replace cracked or defective mortar. Completed manhole shall be rigid and watertight.

### 3.6 *FLEXIBLE PIPE JOINTS AT MANHOLE WALLS*

- A. Provide two 2-foot-long pipe sections from manhole walls. Lay pipes entering manhole base penetrations and resilient connections on compacted base.

### 3.7 *CLEANOUTS*

- A. Cleanouts shall be constructed in accordance with details shown on the Plans.

### 3.8 *EXCAVATION AND BACKFILL*

- A. As specific in Section 31 05 00, Common Work Results for Earthwork.

### 3.9 *EXISTING MANHOLE WORK*

- A. Connection to existing manholes. New piping shall be connected to existing manholes as indicated in the Plans. Core drill, cut or break manhole walls for sewer pipe connections. Install pipe connection to manhole with elastomeric, ring type, water seal embedded in concrete collar at wall. Concrete collar shall be minimum 8 inches around pipe and 6 inches thick from manhole wall, or as shown in the Plans, whichever is greater. The interior of the manhole at the connections shall be finished smooth to match the wall of the manhole.
- B. Manholes to be Abandoned: Manholes to be abandoned shall have the ring and cover removed, including grade rings, cone section, and barrel section to a minimum of two feet below proposed surface. All manhole inlet/outlet pipe penetrations shall be plugged as specified below. Three 1-inch holes shall be cored through each base. Broken pieces of concrete may remain as long as it is impossible for pieces to retain water, collapse, otherwise affect the completed work, and as approved by the Engineer. Backfill as specified in Section 31 05 00, Common Work Results for Earthwork.

- C. Manholes to be Removed: Manholes to be removed shall be removed completely, including base. Backfill as specified in Section 31 05 00, Common Work Results for Earthwork. Plug pipes to be abandoned as specified below.

### 3.10 ABANDONED LINE PLUGS

- A. Plug end of abandoned pipe with concrete plug. Plug shall be 12 inches or two times the pipe diameter in length, whichever is greater. Concrete shall be flush with inside wall of manhole for plugs to be installed from inside manhole.

### 3.11 FIELD QUALITY CONTROL

- A. Verify all precast sections are continuously sealed.

### 3.12 TESTING MANHOLES

- A. Furnish and dispose of water used for testing.
- B. Hydraulically test all manholes installed.
- C. After all pipes have been laid, trenches backfilled, and pipes have been tested, plug the end of the pipe stubs in each manhole with flexible-joint caps, or acceptable alternate.
- D. Fill the manhole with water to a point 1 foot below the cone or flattop soffit or a maximum water depth of 20 feet. Allow the manhole to absorb water for four hours, then refill to the original water level. Measure the loss of water by noting the decrease in water depth in the manhole. Fill the manhole with water and measure leakage over a period of not less than one hour.
- E. Allowable Leakage: less than one (1) gallon per hour per 10-foot depth of manhole.
- F. When leakage from the manhole exceeds the above amount, determine the source or sources of the leakage, and repair or replace defective materials and workmanship.
- G. Repair all visible leaks even if manhole passes the leakage test.

**END SECTION**

**SECTION 40 05 00**  
**PIPE AND FITTINGS**

**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- A. Furnish, install, and test all water, utility, pipe, fittings, and appurtenances as indicated and as specified.

**1.2 RELATED WORK**

- A. Section 03 30 01 - Cast-In-Place Concrete (Site Work)
- B. Section 09 90 01 - Painting and Coating (Site Work)
- C. Section 22 40 10 – Plumbing Specialties (Site Work)
- D. Section 31 23 00 – Earthwork
- E. Section 31 23 16 – Trenching, Backfilling, and Compacting
- F. Section 40 05 23 – Valves & Appurtenances
- G. Section 40 20 10 - Pipe Supports

**1.3 REFERENCES**

- A. California Plumbing Code.
- B. American Water Works Association Standards,

**1.4 SUBMITTAL REQUIREMENTS**

- A. Submit shop drawings in accordance with the General Provisions.
- B. As specified in Section 01 33 00 – Submittal Procedures
- C. Submit manufacturer's catalog data. Show manufacturer's model number.
- D. Submit dimensions including wall thickness and materials of construction by reference standard and grade. Submit information on interior and exterior coatings as applicable.



### 1.5 *QUALITY ASSURANCE*

- A. All work performed under this section shall meet all recommendations and requirements of AWWA, Uniform Plumbing Code (UPC), NFPA 24, ASTM D2774, and all other applicable national, state, local, standards and regulations.

### 1.6 *MATERIALS*

- A. All materials in contact with potable water shall be certified to ANSI/NSF Standard 61.

## **PART 2 PRODUCTS**

### 2.1 *DUCTILE IRON PIPE*

- A. General: Ductile iron pipe shall conform to ANSI A21.51 (AWWA C151), and shall be Class 52 unless shown otherwise. Pipe for grooved or flanged joints shall be no less than Class 53.
- B. Joints:
  - 1. Buried pipe and pipe fittings shall have push-on joints or mechanical joints conforming to AWWA C111. Flanged joints, sleeve-type mechanical couplings, and grooved-type couplings shall be used when shown.
  - 2. For push-on joints, shape of pipe ends shall conform to ANSI A21.11 (AWWA C111). Gaskets and lubricant for pipe and fittings shall conform to ANSI A21.11 (AWWA C111).
  - 3. For mechanical joints, dimensional and material requirements for pipe ends, glands, bolts, nuts, and gaskets shall conform to ANSI A 21.11 (AWWA C111). Pipe smaller than 4 inches shall have screwed or grooved joints
  - 4. For flanged joints, ends of pipe shall be provided with flanges conforming to ANSI A21.15 (AWWA C115), and to ANSI B16.5 for 150 lb. class. Bolts, nuts, and gaskets for flanged connections shall conform to ANSI B18.2.1. For grooved joints, groove specifications shall conform to ANSI/AWWA C606.
- C. Fittings: Fittings with push-on, mechanical joint, grooved joints and flanged ends shall conform to ANSI A21.53 (AWWA C153). Fittings shall have pressure rating of 350 psi for 3"-24" and 250 psi rating for 30"-48" pipe. Fittings shall have cement-mortar lining equivalent to that of the pipe lining.
- D. Coating and Lining: Pipe shall be bituminous seal-coated and cement-mortar lined. The lining shall conform to AWWA C104.
- E. All buried ductile iron pipe shall be encased in an 8 mil lining of polyethylene, installed per AWWA C105.

## 2.2 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

- A. Pipe shall be high molecular weight, high-density polyethylene pipe. The material shall conform to AWWA C906, PPI designation PE 3408 and have a cell classification of 345444C as described in ASTM D 3350 and shall be, TYPE III, Grade PE34. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of same specification from the same raw material pipe. Polyethylene pressure pipe shall also conform to the applicable requirements of ASTM F-714.
- B. Pipe shall be rated for 250 PSI working pressure
- C. The pipe inside diameter shall not be less than the nominal diameter specified or shown.
- D. Unless shown otherwise on the Plans, the pipe dimension ratio shall be SDR 11 for pipes 10 inches and less.
- E. All joints for the buried polyethylene pipe shall be of the thermal fusion type.
- F. Polyethylene fittings shall conform to ASTM D-3261. Each fitting shall be clearly labeled to identify its size and dimension ratio.

## 2.3 STEEL PIPE

- A. General: Steel pipe 12-inches in diameter and smaller shall conform to the requirements of the "Specifications for Black and Hot-Dipped Zinc-Plated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses (ASTM A120), and shall be "Standard Weight" Steel Pipe larger than 12 inches in diameter shall be ASTM A139, AWWA C200, wall thickness not less than 0.18 inches.
- B. Joints: Pipe 4-inches in diameter and larger shall be flanged or shall have grooved ends for Victaulic-type couplings. Where shown on the Plans, the pipe shall be flanged or plain end for flanged coupling adapters. Flanges shall be standard 150 psi flanges meeting the requirements of ANSI B16.1. Flanges shall be furnished with flat faces. Pipe smaller than 4 inches shall have screwed or grooved joints unless shown otherwise on the Plans.
- C. Fittings: All fittings shall be flanged cast or ductile iron, screwed malleable iron, or Victaulic-type fittings. The Contractor may substitute Victaulic-type fittings for flanged fittings or screwed fittings unless the particular joint requires a specific end for compatibility with a valve or special fitting. All Victaulic-type fittings shall be of strength equal to the pipes with lining and coatings equivalent to that specified for the pipe.
- D. Unless otherwise specified or noted in the Plans, all steel pipe 2-1/2 inch and smaller shall be Hot-Dipped galvanized, and pipes larger than 2-1/2 inch shall be black steel with epoxy or lining with minimum 10 mil dry thickness. Exterior

surfaces of all pipe shall be shop primed. Finish coatings shall be as specified in Section 09 90 00 - Painting.

#### 2.4 *POLYVINYL CHLORIDE WATER PIPE (PVC)*

- A. General: PVC pipe 4 inches through 12 inches in diameter shall conform to AWWA C900, unless otherwise specified. PVC pipe 14 inches in diameter and larger shall conform to AWWA C905, unless otherwise specified.
- B. The pipe shall be minimum PR 235 (DR 18) unless shown otherwise. Each length of pipe shall be marked with the manufacturer's name, nominal size, pressure classification, and date of manufacture.
- C. Joints: Joints shall be push-on type couplings or integral socket bell PVC pipe unless otherwise shown with rubber gaskets conforming to ASTM D 3139 and ASTM F 477. Integral socket bells of PVC pipe or separate couplings shall meet the same strength requirements as that of the pipe. All component parts of each joint including gaskets and coupling shall be clearly marked for use with the pipe for which they are intended.
- D. Fittings: Fittings shall be of ductile iron conforming to ANSI A21.10 (AWWA C153) with push-on joint bell to fit the particular make of pipe furnished. Fittings shall have a pressure rating at least equivalent to that of the pipe used and shall be cement-mortar lined in accordance with ANSI A21 (AWWA C104).
- E. Fittings: Fittings shall be of ductile iron conforming to ANSI A21.10 (AWWA C 153) for mechanical joints. Dimensional and material requirements for pipe ends, glands, bolts, nuts, and gaskets shall conform to ANSI A 21.11 (AWWA C111). Pipe smaller than 4 inches shall have screwed or grooved joints

#### 2.5 *POLYVINYL CHLORIDE GRAVITY SEWER PIPE (PVC)*

- A. PVC gravity sewer pipe 4-inches through 15-inches in diameter shall conform to ASTM D 3034, SDR 35. PVC gravity sewer pipe 18-inches through 36 inches in diameter shall conform to ASTM F679.
- B. Each length of pipe shall be marked with the manufacturers name, nominal size and ASTM designation. Pipe shall be made of PVC plastic having a cell classification of 12454B or 12364B as defined in ASTM D1784 and shall have SDR of 35 and minimum pipe stiffness of 46 PSI according to ASTM Test D2412.
- C. Joints: Pipe shall include an integral bell section with a factory assembled rubber ring gasket conforming to ASTM F477. Joint shall conform to ASTM D 3212. Bells shall meet the same strength requirements as that of the pipe.
- D. Fittings: Fittings shall be supplied by the pipe manufacturer and shall meet the strength requirement of the pipe. Integral bells and gaskets shall conform to the requirements for joints in this section. Fittings shall be marked with nominal size, manufacturers name and ASTM designation.

- E. PVC sewer pipe 3 inches to 6 inches, for chemical drain shall conform to ASTM D-2729 and D2949. Fittings shall be PVC with socket welded joints and shall conform to ASTM D2949 and ASTM D2665.

## 2.6 FLEXIBLE COUPLINGS FOR GRAVITY PIPES

- A. Transition type couplings shall be factory manufactured to ensure watertight fit and smooth flow transition at the joint. Couplings shall be made of resilient elastomeric PVC, with all stainless-steel coupling bands including screw and housing. All materials shall be rustproof and unaffected by soil conditions or normal sewer gases, and shall be flexible with earth movement while maintaining seal. Poured concrete collar and similar coupling methods will not be accepted.

## 2.7 STAINLESS STEEL TUBING

- A. Stainless steel tubing shall be made of Type 316 L stainless steel to the requirements of ASTM A 269, of minimum 1/4-inch inside diameter, or as indicated, for the test pressure required. The fittings shall be swage ferrule design of Type 316 L stainless steel, of the double acting ferrule design, providing both a primary seal and a secondary bearing force. Flare bite or compression type fittings are not acceptable.

## 2.8 COPPER PIPE AND TUBING

- A. Copper tubing shall conform to ASTM B88. Copper tubing for water piping shall have a weight of not less than Type K. Type L copper tubing shall be permitted to be used for water piping when piping is above ground in, or on, a building or underground outside of structures
- B. Fittings:
  - 1. Use soldered joints and fittings in exposed tubing service.
  - 2. Use soldered joints and fittings in buried service.
  - 3. Fittings and joints 3/8" and smaller in exposed service may be of the nut-and ferrule type with flared end connections or compression joint connections.
  - 4. Use threaded joints and fittings in buried and exposed copper and brass piping.
- C. Joints from copper tubing to threaded pipe shall be made by the use of brass adapter fittings. The joint between the copper tubing and the fitting shall be a soldered brazed flared, or pressed joint and the connection between the threaded pipe and the fitting shall be made with a standard pipe size screw joint.
- D. Joints in copper tubing shall be made by the appropriate use of approved copper or copper alloy fittings. Surfaces to be joined by soldering shall be cleaned bright by manual or mechanical means. The joints shall be properly fluxed with an

approved type flux and made up with approved solder. Solder and fluxes shall be manufactured to approved standards.

1. Solders and fluxes with a lead content that exceeds two-tenths (0.02) of one (1) percent shall be prohibited in piping systems used to convey potable water.
  2. Solder shall be 95-5 (95% tin, 5% antimony) conforming to ASTM B32, Grade Sb5 or silver solder conforming to AMS 4773C.
  3. Soldering flux shall comply with ASTM B813.
- E. Only brazing alloys having a liquid temperature above 1000°F (538°C) shall be used.
- F. Nut and Ferrule Fittings: Fittings shall be brass and or the Swagelok type as manufactured by Crawford Fitting Company, utilizing a nut and dual ferrule design to connect to tubing. End connections shall be of the union type.
- G. Unions shall be the same size as the pipe or tube, three part, with copper flare end connections. Unions shall be bronze, ASTM B61 or B62. Unions shall be Mueller H-15400, Jones J-1528, or equal.
- H. Provide an insulating union at the point of transition from copper tubing or piping to ferrous piping.
- I. Buried tubing shall be polyethylene coated, tape wrapped, or encased in a PVC sleeve.

## 2.9 CHEMICAL PIPING AND TUBING

- A. Unless otherwise noted on the drawings, chemical piping shall be Schedule 80 PVC or CPVC in accordance with Section 40 20 90. Piping called out as secondary containment piping shall conform to Section 40 24 68.
- B. Where tubing inside of EPVC is called out on the drawings.
1. EPVC shall consist of Schedule 80 PVC conduit or pipe utilizing long radius sweep elbows.
  2. Chemical dosing tubing shall consist of FDA compliant PTFE tubing with a minimum working pressure of 90 psi at 150°F. HDPE, PVC, or PVDF tubing may be substituted provided that they meet the minimum working pressure requirement and are certified by the manufacturer to be suitable for the chemical service with an “excellent” chemical compatibility rating.
  3. Sample tubing shall consist of odorless, tasteless, flexible black polyethylene tubing. Minimum operating pressure shall be 125 psi up to ½-inch in size and shall be ¼ of the burst pressure of the tubing. Tubing shall

comply with ASTM D1248, Type I, Class A, Category 4, Grade E and shall be certified to ANSI/NSF Standard 61.

4. Fittings for tubing shall be compression type fittings rated at 150 psi minimum and constructed of a material compatible with the chemical service.

## 2.10 GROOVED COUPLINGS

- A. Groove dimensions shall conform to AWWA C606.
- B. Grooved couplings for ductile iron shall be Victaulic Style 31;
- C. Flexible grooved couplings for steel pipe shall be Victaulic Style 77 or equal; rigid grooved couplings for steel pipe shall be Victaulic Style 07 or equal. Couplings shall be rigid unless otherwise noted on the drawings.
- D. Grooved - Flanged adapters shall be Victaulic Style 341 for ductile iron pipe and Style 741 for steel pipe or equal.
- E. Grooved coupling for high density polyethylene pipe shall be Victaulic Style 995 or 997 or equal.

## 2.11 FLANGED JOINTS

- A. Flange shall conform to ANSI B16.5, Class 150.
- B. All steel hardware installed underground shall be coated with a rust preventative, wrapped with 4 mil polyethylene sheeting, and secured with PVC tape.
- C. Gaskets shall meet the pressure requirements of the adjoining flanges and shall conform to AWWA C-207. Gaskets for flat faced flanges shall be 1/8-inch thick.
- D. Gaskets for metallic pipe and non-potable 150 psi or less services shall be acrylic or aramid fiber bound with nitrile; Garlock Blue-Gard 3000 or equal. EPDM rubber gaskets, Garlock 98206 or equal, are also acceptable.
- E. Gaskets for metallic pipe and potable water service shall be NSF/ANSI-61 certified EPDM rubber, Garlock 98206 or equal.
- F. Gaskets for non-metallic flat faced flanges shall be constructed of a fluoroelastomeric material with a hardness of 70 durometer designed specifically for lower seating stress. Gaskets shall be certified to NSF/ANSI-61 for potable water service. Gaskets shall be Garlock Style XP or equal.

## 2.12 FLEXIBLE SLEEVE COUPLINGS

- A. Flexible sleeve couplings shall be one of the following, or Engineer approved equivalent:

1. Dresser, Inc., Style 38 for Steel Pipe, and Style 253 Wide- Range for Steel, PVC, Copper, and Cast/Ductile Iron pipe.
2. Smith Blair, Inc., Series 411 or Wide-Range 461
3. Romac Industries, Inc., Style 400 for 12” and larger pipe or XR501 Extended Range Coupling, 4” thru 12” pipe size.

B. Center sleeves shall comply with the following

Nominal Pipe Diameter	Minimum Sleeve Length
6 inch and smaller	Manufacturer’s Standard
8 through 14 inch	7 inch
14 inch and larger	10 inch

**2.13 FLEXIBLE SPOOL-TYPE EXPANSION COUPLINGS**

- A. Flexible rubber coupling shall be flexible joints, which includes a tube, body cover and flanges. The tube shall be a leak proof liner and the body shall consist of fabric and rubber compound, reinforced with steel wire or rings for strength. Flexible rubber coupling shall be either a single arch or double arch construction as indicated in the Plans. Couplings shall have control rods to limit extension and flanges shall have backing rings. Couplings used for services with pressures greater than 75 psi shall have stainless steel flanges – rubber flanges with backing rings shall not be acceptable. Flexible couplings shall have minimum pressure ratings of 100 psi; couplings installed on suction of pumps shall have a minimum vacuum (pressure) rating of 30 inches Hg column.
1. Flexible coupling shall have Buna N liner and cover and shall be manufactured by Proco, Red Valve Company Inc., Metraflex Company or equal.

**2.14 DOUBLE-SOCKET EXPANSION JOINT**

- A. Flexible expansion joints shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53.
- B. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 250 PSI. A minimum 2:1 safety factor, determined from the published pressure rating, shall apply.
- C. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 25°, 4” - 8”; 20°, 10” - 12”; 15°, 14+” and 8-inches minimum expansion. The flexible expansion fitting shall not expand or exert an axial imparting thrust under internal water pressure. The flexible expansion fitting shall not increase or decrease the internal water volume as the unit expands or contracts.

- D. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61.
- E. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.
- F. Joints shall be The Force Balanced FLEX-TEND as manufactured by EBAA Iron, or equal.

#### 2.15 *MARKER TAPE FOR BURIED PIPING*

Not used

#### 2.16 *TRACER WIRE*

Install No. 10 solid-core copper tracer wire

#### 2.17 *CONCRETE FOR THRUST BLOCKS*

- A. As specified in Section 03 30 00 – Cast In Place Concrete. Thrust blocks shall be used only where specifically permitted on the drawings or with pre-approval from the Engineer.

#### 2.18 *JOINT RESTRAINT COUPLINGS*

- A. Mechanical joint restraint coupling shall be of the type that utilizes the follower gland, and shall consist of several individual lug bolts with gripping mechanism that prevents the joints from pulling apart. Glands shall be ductile iron conforming to ASTM A536-80, and dimensions shall be compatible to be used with standard mechanical joint fittings for ductile rim pipe. The mechanical restraint joint shall have a minimum working pressure rating equal to that of the pipe with a safety factor of not less than 2. Restrained joints shall have twist off nuts to insure proper installation of restraining grip mechanism. Mechanical joint restrained coupling shall be EBAA, Iron, Inc. MEGALUG; with Mega-Bond coating.; or approved equal. Coating of gland follower body shall be electrostatically applied and heat cured polyester based powder. Wedge assemblies and bolts shall be coated with heat cured fluoropolymer coatings. Restraints shall be designed for the specific type of pipe to be restrained.
- B. Restrained joint fittings shall meet Uni-B-13 for PVC and be FM and UL approved through 12 inch for both ductile iron and PVC.
- C. Restrained joint fittings for high density polyethylene pipe shall be Victaulic 995 or 997 style coupling.



## 2.19 FASTENERS

- A. All fasteners shall include washers under both bolt head and nut unless the use of washers is incompatible with the fitting design.
- B. Unless otherwise noted, all bolts, tie rods, and T-bolts used to secure flanges, fittings, and couplings located underground or submerged in liquid shall be Type 304 or 316 stainless steel per ASTM A320 or ASTM A193. Nuts shall be 304 or 316 stainless steel per ASTM A 194 and washers shall be ASTM F436 Type 3.
- C. Unless otherwise noted, all bolts, tie rods, and T-bolts used to secure flanges, fittings, and couplings located indoors, above grade, and in vaults shall be carbon steel conforming to ASTM A307, Grade B with ASTM A563A nuts and ASTM F436 washers. Bolts, nuts, and washers shall be hot dipped galvanized in accordance with ASTM F2329. Stainless steel meeting the requirements of Paragraph B shall also be acceptable.

## 2.20 INSULATING FLANGE SETS

- A. Insulating flange sets shall be provided where indicated on the plans and shall consist of insulating gaskets, insulating sleeves and washers and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2-inch or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2-inch, insulating sleeves and washers shall be 2-piece and shall be made of polyethylene or phenolic. Steel washers shall comply with ASTM A 325. Insulating gaskets shall be full-face.

## PART 3 EXECUTION

### 3.1 HANDLING AND DISTRIBUTION OF MATERIALS

- A. Delivery: Handle pipe carefully to ensure delivery at the project site in sound, undamaged condition. Contractor shall replace damaged pipe at no additional expense to the Owner.
- B. Storage: Do not store materials directly on the ground. Adequately support piping to prevent warping. Use protective covers where pipe may be damaged by direct sunlight.
- C. No more than one week's supply of material shall be distributed in advance of pipe laying operations, unless otherwise approved or required.
- D. Before laying, pipe shall be inspected for cracked, broken, or defective pieces. Such pieces shall be rejected. Pipe shall be carefully lowered into the trench to prevent damage. All dirt or other foreign matter shall be removed from inside the pipe before lowering into the trench.

### 3.2 COATING

- A. Unless otherwise indicated in Part 2, all pipe and fittings shall be coated in accordance with specification 09 90 00.

### 3.3 INSTALLATION OF UNDERDRAINS

- A. Perforated pipes shall be laid with the perforations down.

### 3.4 INSTALLATION OF BURIED PRESSURE PIPING

- A. General: Pipe, fittings, and appurtenances shall be installed in accordance with the manufacturer's instructions and in accordance with the following references as appropriate:

1. Ductile Iron Pipe - AWWA C600
2. Polyvinyl Chloride Pipe and HDPE pipe - AWWA C605.
3. Steel Pipe – AWWA C604

- B. Handling: The pipe shall be protected to prevent entrance of foreign materials during laying operations. When laying is not in progress, open pipe ends shall be protected with a watertight plug or other approved means to exclude water or foreign material.

- C. Alignment:

1. Mains shall be installed to the grades and elevations indicated and shall have a minimum cover of 30-inches from the top of the pipe to existing ground or paved surface unless otherwise indicated.
2. The allowable angle of deflection at any joint shall not exceed the amount recommended by the pipe manufacturer for the particular pipe size used. Deviation of any pipe section from the line and grade indicated shall not exceed 1/2-inch.

- D. Joints:

1. Pipe shall be assembled and joined in accordance with the manufacturer's published instructions for the type of pipe and joint used. All portions of the joints shall be thoroughly cleaned before the sections of pipe are assembled. The ends of each pipe shall abut against the next pipe section in such a manner that there shall be no unevenness of any kind along the bottom half of the interior of the pipe. Where mechanical joints are used, the pipe shall be marked in such a manner that it can be determined after installation that the pipe is properly seated.
2. Where flexible couplings are used as expansion joints, the ends of the pipes shall be separated 1-inch to allow for expansion. The welded seam at the

end of each coupled steel pipe shall be ground smooth for approximately 12-inches. Couplings shall be centered on pipe ends. Runs of pipe containing flexible couplings shall be properly blocked, anchored or tied to the structure to prevent joints from separating.

3. Mechanical restrained joints shall be installed in accordance with joint manufacturer's instructions and recommendation.
- E. Installation of Marker Tape: Install tape in backfill directly over each pipeline, 24 inches over top of pipe, unless shown otherwise on the Plans. Where utilities are buried in a common trench, identify each line by a separate marker tape. Place tapes directly over the applicable line.

### 3.5 *THRUST BLOCKS OR MECHANICAL RESTRAINED JOINTS*

- A. Thrust blocks shall be used only where specifically allowed on the drawings or with prior approval by the Engineer.
- B. Place concrete thrust blocks at all tees, elbows, plugs, and other locations where unbalanced forces exist in underground pipe in accordance with details shown. Place blocks between undisturbed ground and fitting to be anchored. Place blocking so that pipe and fittings will be accessible for repairs. Thrust blocks shall be of such size as to give bearing against undisturbed vertical earth banks sufficient to absorb the thrust from line pressure, allowing a maximum earth bearing pressure of 500 pounds per square foot per foot of depth below natural grade or as shown.
- C. Restrained joint fittings may be used in-lieu of thrust blocks, at the discretion of the Engineer. Contractor shall submit shop drawings showing methods of joint restraint for each type of restrained joint fitting to be used including the length of pipe having restrained push-on joints on all pipes which connect to the restrained fitting.
- D. When it is necessary to restrain push-on joints adjacent to restrained fittings, a harness restraint device shall be used. All harnesses shall have a pressure rating equal to that of the pipe on which it is used. Harness assemblies including tie bolts conform to ASTM A536-80.

### 3.6 *INSTALLATION OF EXPOSED PIPING*

- A. General - Pipe shall be installed as specified, as indicated on the Plans or, in the absence of detail piping arrangement, in a manner acceptable to the Engineer.
- B. Pipe shall be cut from measurements taken at the site and not from the Plans. All necessary provisions shall be taken in laying out piping to provide throughout for expansion and contraction. Piping shall not obstruct openings or passageways. Pipes shall be held free of contact with building construction so as not to transmit noise resulting from expansion.

- C. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, dirt, and other foreign matter when erected. The interior of all lines shall be thoroughly cleaned, to the satisfaction of the Engineer, before being placed in service.
- D. Stuffing box leakage from water sealed pumps shall be contained and not allowed to into storm drains.
- E. Taps for pressure gauge connections on piping and equipment shall be provided with a nipple and a ball type shutoff valve. Drilling and tapping of pipe walls for installation of pressure gauges or switches will not be permitted.
- F. A union shall be provided within 2 feet of each end of threaded end valves unless there are other connections that facilitate easy removal of the valve. Unions shall also be provided in piping at locations adjacent to devices or equipment that may require removal in the future and at locations required by the Plans or other sections of the Specifications.
- G. Provide unions on exposed piping and tubing 3-inches and smaller as follows:
  - 1. At every change in direction (horizontal and vertical).
  - 2. Downstream of valves, 6 to 12 inches.
  - 3. As shown on plans.
- H. In all piping except air piping, insulating fittings shall be provided to prevent contact of dissimilar metals.
- I. Pipe Joints - Pipe joints shall be carefully and neatly made in accordance with the requirements that follow.
  - 1. Threaded - Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be full and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed, after threading and before assembly, to remove all burrs.

Threaded joints in plastic piping shall be made up with Teflon thread tape applied to all male threads. Threaded joints in stainless steel piping shall be made up with Teflon thread sealer and Teflon thread tape applied to all male threads. At the option of the Contractor, threaded joints in other piping may be made up with Teflon thread tape, thread sealer, or a suitable joint compound. Thread tape and joint compound or sealers shall not be used in threaded joints that are to be seal welded.

Threaded joints in steel piping for chlorine service shall be made up with Teflon thread tape or paste applied to all male threads.

2. Compression - Ends of tubing shall be cut square and all burrs shall be removed. The tubing end shall be fully inserted into the compression fitting and the nut shall be tightened not less than 1-1/4 turns and not more than 1-1/2 turns past finger tight, or as recommended by the fitting manufacturer, to produce a leak tight, torque-free connection.
3. Flared - Ends of annealed copper tubing shall be cut square and all burrs shall be removed prior to flaring. Ends shall be uniformly flared without scratches or grooves. Fittings shall be tightened as required to produce leak tight connections.
4. Soldered and Brazed - Where solder fittings are specified for lines smaller than 2 inches, joints may be soldered or brazed at the option of the Contractor. Joints in 2 inch and larger copper tubing shall be brazed.
5. Flanged - Flange bolts shall be tightened sufficiently to slightly compress the gasket and effect a seal, but not so tight as to fracture or distort the flanges. A plain washer shall be installed under the head and nut of bolts connecting plastic pipe flanges. Anti-seize thread lubricant shall be applied to the threaded portion of all stainless steel bolts during assembly. Connecting flanges shall have similar facings, i.e., flat or raised face.
6. Welded - Welding shall conform to the specifications and recommendations contained in the "Code for Pressure Piping", ANSI B31.1.
7. Grooved Couplings - Grooves for grooved couplings shall be cut with a specially designed grooving tool. Grooves cut in steel pipe shall conform to flexible grooving dimensions as set forth in AWWA C606, and shall be clean and sharp without burrs or check marks.

### 3.7 ACCEPTANCE TESTS AND INSPECTION FOR GRAVITY PIPING

#### A. General.

1. All testing and inspection shall be performed after final backfill and compaction operations are complete. If the Contractor so desires, he may pretest the lines at his own expense, but final testing must be performed after compaction requirements have been approved.
2. If any of the tests or inspections covered in this section indicates that sewers require repair, then after repairs are complete, all testing and inspection shall be performed again. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project.
3. Prior to testing, all lines shall be thoroughly cleaned by flushing, and shall have passed a Wayne ball of appropriate size. Contractor is to submit to the Engineer a detailed procedure on protecting the existing sewer system from contaminants during the flushing operation.

B. Mandrel

1. All sections of completed gravity pipe main lines shall be tested to assure that no potential obstructions are present in the lines. A rigid mandrel with a circular cross section having a diameter not less than 95% of the specified pipe diameter shall pass through the pipe without resistance.

C. Low-Pressure Air Test

1. Supply air to the test section slowly. A constant pressure of 3.5 psig shall be reached and maintain internal pressure of at least 3.0 psig for at least five (5) minutes.
2. After the stabilization period, disconnect the air supply. A pressure loss of 0.5 psig is used to compute the allowable pressure loss using the following formula.
3. The minimum allowable time in minutes for such a pressure drop is determined from the formula  $T_{\min} = 0.000183D^2L$ , where:
  - a.  $D$  = Nominal inside diameter of pipe (inches)
  - b.  $L$  = Length of pipe test section (feet)
4. Regardless of the formula, the minimum time allowed for pressure drop shall be eight (8) minutes.
5. The pressure gage for monitoring the air pressure shall have a minimum division of 0.10 psi increments.
6. A valid test is when the air pressure is released from the opposite end of the inlet air entry connection with an air release apparatus outlet connection.
7. Adjustment of Pressure for Groundwater. Should the pipe section being tested lie below the local groundwater table, the test pressures shall be raised in proportion to the depth of the centerline of the pipe below the water table. Additional pressure (beyond the 3.5 psig specified above) shall be added at the rate of 0.433 psig per foot of depth below groundwater.

D. Video

1. Video inspection shall be performed on all new sewer mains. Video inspections shall be paid for by the Contractor and shall be completed prior to the final acceptance of the improvements.
2. The inspection shall be in color, and shall be recorded on VHS-format 1/2" tape or DVD, which shall become the property of the Owner.
3. The Engineer shall be the sole judge as to the acceptability of construction revealed by such inspection.

4. Within 24 hours prior to testing, all lines shall be thoroughly flushed with water to assist camera in the identification of low areas.

### 3.8 ACCEPTANCE TESTS FOR BURIED PRESSURE PIPING

#### A. General.

1. All testing and inspection shall be performed after final backfill and compaction operations are complete. If the Contractor so desires, he may pretest the lines at his own expense, but final testing must be performed after compaction requirements have been approved.

#### B. In general, tests shall be conducted in accordance with AWWA C600 and C651 except as otherwise herein specified.

#### C. All newly installed sections of buried pressure piping shall be pressure and leakage tested as described herein.

1. For buried pressure pipelines, tests shall be made on two or more valved sections not to exceed 2,500 feet in length. The Contractor shall furnish all necessary equipment, material and labor required.
2. Tests shall be made after the trench has been backfilled and compacted, but not until at least 5 days have elapsed since any thrust blocks in the section have been poured.
3. The pipe shall be slowly filled with water and ensuring all air expelled from section being tested. The line shall stand full of water for at least twenty-four hours prior to testing to allow all air to escape. A test pressure equal to 1.5 times the design pressure, of the pipe measured at the point of lowest elevation pressure, or 100 psi, whichever is greater, shall be applied.
4. The test pressure in the line shall be maintained for a period of 2 hours. Test pressure shall be maintained within 5 psi during the test period. Conduct a leakage test concurrently with the pressure test. Leakage is defined as the volume of water that must be supplied into the newly laid pipeline to maintain pressure within +/- 5 psi of the test pressure after it is filled and purged of air. The water required to maintain test pressure shall be measured by means of a graduated barrel, drum, or similar device at the pump suction or through a meter.

Allowable leakage at the specified test pressure shall not exceed the amounts allowed by AWWA C600,  $L = \frac{SD\sqrt{P}}{148,000}$

Where:

L = Testing allowance in gallon per hour.

S = Length of pipe tested in feet.

D = Nominal diameter of the pipe in inches.

P = Average test pressure during the hydrostatic test, in pounds per sq. inch.

Hydrostatic testing allowance per 1,000 ft. of pipeline in gph.

PSI	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
200	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29
175	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15
150	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99
125	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81
100	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62

5. Should testing disclose any visible leaks or leakage greater than that allowed, the defective joints or pipe shall be located, repaired, and re-tested until satisfactory. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project.

### 3.9 ACCEPTANCE TEST FOR EXPOSED PIPING

- A. Pipe to be Tested - All new installed piping sections shall be pressure and leakage tested as specified herein.
- B. Pressure Testing - After the section of line to be tested has been filled with water or other test media, the test pressure shall be applied and maintained without interruption for 2 hours plus any additional time required for the Engineer to examine all piping undergoing the test and for the Contractor to locate all defective joints and materials.
  1. Test medium shall be potable water for potable water piping; all other piping may be tested using plant water subject to Engineer's approval.
  2. Pipe system shall be tested at 1-1/2 times the operating pressure, or 100 psi, whichever is greater, using the appropriate test fluid medium.



3. All piping shall be tight and free from leaks. All pipe, fittings, valves, pipe joints, and other materials that are found to be defective shall be removed and repaired or replaced with new and acceptable material, and the affected portion of the piping be retested until satisfactory. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project.

Compressed air or gas under pressure shall not be used to test plastic piping unless specifically recommended by the pipe manufacturer.

Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method acceptable to the Engineer. All fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the specified test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.

**END OF SECTION**

**SECTION 40 05 00**  
**PIPE AND FITTINGS**

**PART 1 GENERAL**

*1.1 WORK INCLUDED*

- A. Furnish, install, and test all water, utility, pipe, fittings, and appurtenances as indicated and as specified.

*1.2 RELATED WORK*

- A. Section 03 30 01 - Cast-In-Place Concrete (Site Work)
- B. Section 09 90 01 - Painting and Coating (Site Work)
- C. Section 22 40 10 – Plumbing Specialties (Site Work)
- D. Section 31 23 00 – Earthwork
- E. Section 31 23 16 – Trenching, Backfilling, and Compacting
- F. Section 40 05 23 – Valves & Appurtenances
- G. Section 40 20 10 - Pipe Supports

*1.3 REFERENCES*

- A. California Plumbing Code.
- B. American Water Works Association Standards,

*1.4 SUBMITTAL REQUIREMENTS*

- A. Submit shop drawings in accordance with the General Provisions.
- B. As specified in Section 01 33 00 – Submittal Procedures
- C. Submit manufacturer's catalog data. Show manufacturer's model number.
- D. Submit dimensions including wall thickness and materials of construction by reference standard and grade. Submit information on interior and exterior coatings as applicable.

### 1.5 QUALITY ASSURANCE

- A. All work performed under this section shall meet all recommendations and requirements of AWWA, Uniform Plumbing Code (UPC), NFPA 24, ASTM D2774, and all other applicable national, state, local, standards and regulations.

### 1.6 MATERIALS

- A. All materials in contact with potable water shall be certified to ANSI/NSF Standard 61.

## PART 2 PRODUCTS

### 2.1 DUCTILE IRON PIPE

A. For Potable Water Service

1. General: Ductile iron pipe shall conform to ANSI A21.51 (AWWA C151), and shall be Class 52 unless shown otherwise. Pipe for grooved or flanged joints shall be no less than Class 53.
2. Joints:
  - a. Buried pipe and pipe fittings shall have push-on joints or mechanical joints conforming to AWWA C111. Flanged joints, sleeve-type mechanical couplings, and grooved-type couplings shall be used when shown.
  - b. For push-on joints, shape of pipe ends shall conform to ANSI A21.11 (AWWA C111). Gaskets and lubricant for pipe and fittings shall conform to ANSI A21.11 (AWWA C111).
  - c. For mechanical joints, dimensional and material requirements for pipe ends, glands, bolts, nuts, and gaskets shall conform to ANSI A 21.11 (AWWA C111). Pipe smaller than 4 inches shall have screwed or grooved joints
  - d. For flanged joints, ends of pipe shall be provided with flanges conforming to ANSI A21.15 (AWWA C115), and to ANSI B16.5 for 150 lb. class. Bolts, nuts, and gaskets for flanged connections shall conform to ANSI B18.2.1. For grooved joints, groove specifications shall conform to ANSI/AWWA C606.
3. Fittings: Fittings with push-on, mechanical joint, grooved joints and flanged ends shall conform to ANSI A21.53 (AWWA C153). Fittings shall have pressure rating of 350 psi for 3"-24" and 250 psi rating for 30"-48" pipe. Fittings shall have cement-mortar lining equivalent to that of the pipe lining.

4. Coating and Lining: Pipe shall be bituminous seal-coated and cement-mortar lined. The lining shall conform to AWWA C104.
  5. All buried ductile iron pipe shall be encased in an 8 mil lining of polyethylene, installed per AWWA C105.
- B. For Sanitary Sewer Service – See Specification Section 33 31 13 – Gravity Sewer Piping and Appurtenances

## 2.2 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

- A. Pipe shall be high molecular weight, high-density polyethylene pipe. The material shall conform to AWWA C906, PPI designation PE 3408 and have a cell classification of 345444C as described in ASTM D 3350 and shall be, TYPE III, Grade PE34. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of same specification from the same raw material pipe. Polyethylene pressure pipe shall also conform to the applicable requirements of ASTM F-714.
- B. Pipe shall be rated for 250 PSI working pressure
- C. The pipe inside diameter shall not be less than the nominal diameter specified or shown.
- D. Unless shown otherwise on the Plans, the pipe dimension ratio shall be SDR 11 for pipes 10 inches and less.
- E. All joints for the buried polyethylene pipe shall be of the thermal fusion type.
- F. Polyethylene fittings shall conform to ASTM D-3261. Each fitting shall be clearly labeled to identify its size and dimension ratio.

## 2.3 STEEL PIPE

- A. General: Steel pipe 12-inches in diameter and smaller shall conform to the requirements of the "Specifications for Black and Hot-Dipped Zinc-Plated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses (ASTM A120), and shall be "Standard Weight" Steel Pipe larger than 12 inches in diameter shall be ASTM A139, AWWA C200, wall thickness not less than 0.18 inches.
- B. Joints: Pipe 4-inches in diameter and larger shall be flanged or shall have grooved ends for Victaulic-type couplings. Where shown on the Plans, the pipe shall be flanged or plain end for flanged coupling adapters. Flanges shall be standard 150 psi flanges meeting the requirements of ANSI B16.1. Flanges shall be furnished with flat faces. Pipe smaller than 4 inches shall have screwed or grooved joints unless shown otherwise on the Plans.
- C. Fittings: All fittings shall be flanged cast or ductile iron, screwed malleable iron, or Victaulic-type fittings. The Contractor may substitute Victaulic-type fittings for

flanged fittings or screwed fittings unless the particular joint requires a specific end for compatibility with a valve or special fitting. All Victaulic-type fittings shall be of strength equal to the pipes with lining and coatings equivalent to that specified for the pipe.

- D. Unless otherwise specified or noted in the Plans, all steel pipe 2-1/2 inch and smaller shall be Hot-Dipped galvanized, and pipes larger than 2-1/2 inch shall be black steel with epoxy or lining with minimum 10 mil dry thickness. Exterior surfaces of all pipe shall be shop primed. Finish coatings shall be as specified in Section 09 90 00 - Painting.

#### 2.4 POLYVINYL CHLORIDE WATER PIPE (PVC)

- A. General: PVC pipe 4 inches through 12 inches in diameter shall conform to AWWA C900, unless otherwise specified. PVC pipe 14 inches in diameter and larger shall conform to AWWA C905, unless otherwise specified.
- B. The pipe shall be minimum PR 235 (DR 18) unless shown otherwise. Each length of pipe shall be marked with the manufacturer's name, nominal size, pressure classification, and date of manufacture.
- C. Joints: Joints shall be push-on type couplings or integral socket bell PVC pipe unless otherwise shown with rubber gaskets conforming to ASTM D 3139 and ASTM F 477. Integral socket bells of PVC pipe or separate couplings shall meet the same strength requirements as that of the pipe. All component parts of each joint including gaskets and coupling shall be clearly marked for use with the pipe for which they are intended.
- D. Fittings: Fittings shall be of ductile iron conforming to ANSI A21.10 (AWWA C153) with push-on joint bell to fit the particular make of pipe furnished. Fittings shall have a pressure rating at least equivalent to that of the pipe used and shall be cement-mortar lined in accordance with ANSI A21 (AWWA C104).
- E. Fittings: Fittings shall be of ductile iron conforming to ANSI A21.10 (AWWA C 153) for mechanical joints. Dimensional and material requirements for pipe ends, glands, bolts, nuts, and gaskets shall conform to ANSI A 21.11 (AWWA C111). Pipe smaller than 4 inches shall have screwed or grooved joints

#### 2.5 POLYVINYL CHLORIDE GRAVITY SEWER PIPE (PVC)

- A. PVC gravity sewer pipe 4-inches through 15-inches in diameter shall conform to ASTM D 3034, SDR 35. PVC gravity sewer pipe 18-inches through 36 inches in diameter shall conform to ASTM F679.
- B. Each length of pipe shall be marked with the manufacturers name, nominal size and ASTM designation. Pipe shall be made of PVC plastic having a cell classification of 12454B or 12364B as defined in ASTM D1784 and shall have SDR of 35 and minimum pipe stiffness of 46 PSI according to ASTM Test D2412.

- C. Joints: Pipe shall include an integral bell section with a factory assembled rubber ring gasket conforming to ASTM F477. Joint shall conform to ASTM D 3212. Bells shall meet the same strength requirements as that of the pipe.
- D. Fittings: Fittings shall be supplied by the pipe manufacturer and shall meet the strength requirement of the pipe. Integral bells and gaskets shall conform to the requirements for joints in this section. Fittings shall be marked with nominal size, manufacturers name and ASTM designation.
- E. PVC sewer pipe 3 inches to 6 inches, for chemical drain shall conform to ASTM D-2729 and D2949. Fittings shall be PVC with socket welded joints and shall conform to ASTM D2949 and ASTM D2665.

## 2.6 FLEXIBLE COUPLINGS FOR GRAVITY PIPES

- A. Transition type couplings shall be factory manufactured to ensure watertight fit and smooth flow transition at the joint. Couplings shall be made of resilient elastomeric PVC, with all stainless-steel coupling bands including screw and housing. All materials shall be rustproof and unaffected by soil conditions or normal sewer gases, and shall be flexible with earth movement while maintaining seal. Poured concrete collar and similar coupling methods will not be accepted.

## 2.7 STAINLESS STEEL TUBING

- A. Stainless steel tubing shall be made of Type 316 L stainless steel to the requirements of ASTM A 269, of minimum 1/4-inch inside diameter, or as indicated, for the test pressure required. The fittings shall be swage ferrule design of Type 316 L stainless steel, of the double acting ferrule design, providing both a primary seal and a secondary bearing force. Flare bite or compression type fittings are not acceptable.

## 2.8 COPPER PIPE AND TUBING

- A. Copper tubing shall conform to ASTM B88. Copper tubing for water piping shall have a weight of not less than Type K. Type L copper tubing shall be permitted to be used for water piping when piping is above ground in, or on, a building or underground outside of structures
- B. Fittings:
  - 1. Use soldered joints and fittings in exposed tubing service.
  - 2. Use soldered joints and fittings in buried service.
  - 3. Fittings and joints 3/8" and smaller in exposed service may be of the nut-and ferrule type with flared end connections or compression joint connections.
  - 4. Use threaded joints and fittings in buried and exposed copper and brass piping.

- C. Joints from copper tubing to threaded pipe shall be made by the use of brass adapter fittings. The joint between the copper tubing and the fitting shall be a soldered brazed flared, or pressed joint and the connection between the threaded pipe and the fitting shall be made with a standard pipe size screw joint.
- D. Joints in copper tubing shall be made by the appropriate use of approved copper or copper alloy fittings. Surfaces to be joined by soldering shall be cleaned bright by manual or mechanical means. The joints shall be properly fluxed with an approved type flux and made up with approved solder. Solder and fluxes shall be manufactured to approved standards.
  - 1. Solders and fluxes with a lead content that exceeds two-tenths (0.02) of one (1) percent shall be prohibited in piping systems used to convey potable water.
  - 2. Solder shall be 95-5 (95% tin, 5% antimony) conforming to ASTM B32, Grade Sb5 or silver solder conforming to AMS 4773C.
  - 3. Soldering flux shall comply with ASTM B813.
- E. Only brazing alloys having a liquid temperature above 1000°F (538°C) shall be used.
- F. Nut and Ferrule Fittings: Fittings shall be brass and or the Swagelok type as manufactured by Crawford Fitting Company, utilizing a nut and dual ferrule design to connect to tubing. End connections shall be of the union type.
- G. Unions shall be the same size as the pipe or tube, three part, with copper flare end connections. Unions shall be bronze, ASTM B61 or B62. Unions shall be Mueller H-15400, Jones J-1528, or equal.
- H. Provide an insulating union at the point of transition from copper tubing or piping to ferrous piping.
- I. Buried tubing shall be polyethylene coated, tape wrapped, or encased in a PVC sleeve.

## 2.9 CHEMICAL PIPING AND TUBING

- A. Unless otherwise noted on the drawings, chemical piping shall be Schedule 80 PVC or CPVC in accordance with Section 40 20 90. Piping called out as secondary containment piping shall conform to Section 40 24 68.
- B. Where tubing inside of EPVC is called out on the drawings.
  - 1. EPVC shall consist of Schedule 80 PVC conduit or pipe utilizing long radius sweep elbows.

2. Chemical dosing tubing shall consist of FDA compliant PTFE tubing with a minimum working pressure of 90 psi at 150°F. HDPE, PVC, or PVDF tubing may be substituted provided that they meet the minimum working pressure requirement and are certified by the manufacturer to be suitable for the chemical service with an “excellent” chemical compatibility rating.
3. Sample tubing shall consist of odorless, tasteless, flexible black polyethylene tubing. Minimum operating pressure shall be 125 psi up to ½-inch in size and shall be ¼ of the burst pressure of the tubing. Tubing shall comply with ASTM D1248, Type I, Class A, Category 4, Grade E and shall be certified to ANSI/NSF Standard 61.
4. Fittings for tubing shall be compression type fittings rated at 150 psi minimum and constructed of a material compatible with the chemical service.

#### 2.10 GROOVED COUPLINGS

- A. Groove dimensions shall conform to AWWA C606.
- B. Grooved couplings for ductile iron shall be Victaulic Style 31;
- C. Flexible grooved couplings for steel pipe shall be Victaulic Style 77 or equal; rigid grooved couplings for steel pipe shall be Victaulic Style 07 or equal. Couplings shall be rigid unless otherwise noted on the drawings.
- D. Grooved - Flanged adapters shall be Victaulic Style 341 for ductile iron pipe and Style 741 for steel pipe or equal.
- E. Grooved coupling for high density polyethylene pipe shall be Victaulic Style 995 or 997 or equal.

#### 2.11 FLANGED JOINTS

- A. Flange shall conform to ANSI B16.5, Class 150.
- B. All steel hardware installed underground shall be coated with a rust preventative, wrapped with 4 mil polyethylene sheeting, and secured with PVC tape.
- C. Gaskets shall meet the pressure requirements of the adjoining flanges and shall conform to AWWA C-207. Gaskets for flat faced flanges shall be 1/8-inch thick.
- D. Gaskets for metallic pipe and non-potable 150 psi or less services shall be acrylic or aramid fiber bound with nitrile; Garlock Blue-Gard 3000 or equal. EPDM rubber gaskets, Garlock 98206 or equal, are also acceptable.
- E. Gaskets for metallic pipe and potable water service shall be NSF/ANSI-61 certified EPDM rubber, Garlock 98206 or equal.



- F. Gaskets for non-metallic flat faced flanges shall be constructed of a fluoroelastomeric material with a hardness of 70 durometer designed specifically for lower seating stress. Gaskets shall be certified to NSF/ANSI-61 for potable water service. Gaskets shall be Garlock Style XP or equal.

#### 2.12 FLEXIBLE SLEEVE COUPLINGS

- A. Flexible sleeve couplings shall be one of the following, or Engineer approved equivalent:
1. Dresser, Inc., Style 38 for Steel Pipe, and Style 253 Wide- Range for Steel, PVC, Copper, and Cast/Ductile Iron pipe.
  2. Smith Blair, Inc., Series 411 or Wide-Range 461
  3. Romac Industries, Inc., Style 400 for 12" and larger pipe or XR501 Extended Range Coupling, 4" thru 12" pipe size.
- B. Center sleeves shall comply with the following

Nominal Pipe Diameter	Minimum Sleeve Length
6 inch and smaller	Manufacturer's Standard
8 through 14 inch	7 inch
14 inch and larger	10 inch

#### 2.13 FLEXIBLE SPOOL-TYPE EXPANSION COUPLINGS

- A. Flexible rubber coupling shall be flexible joints, which includes a tube, body cover and flanges. The tube shall be a leak proof liner and the body shall consist of fabric and rubber compound, reinforced with steel wire or rings for strength. Flexible rubber coupling shall be either a single arch or double arch construction as indicated in the Plans. Couplings shall have control rods to limit extension and flanges shall have backing rings. Couplings used for services with pressures greater than 75 psi shall have stainless steel flanges – rubber flanges with backing rings shall not be acceptable. Flexible couplings shall have minimum pressure ratings of 100 psi; couplings installed on suction of pumps shall have a minimum vacuum (pressure) rating of 30 inches Hg column.
1. Flexible coupling shall have Buna N liner and cover and shall be manufactured by Proco, Red Valve Company Inc., Metraflex Company or equal.

#### 2.14 DOUBLE-SOCKET EXPANSION JOINT

- A. Flexible expansion joints shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53.
- B. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 250 PSI. A minimum 2:1 safety factor, determined from the published pressure rating, shall apply.

- C. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 25°, 4" - 8"; 20°, 10" - 12"; 15°, 14+" and 8-inches minimum expansion. The flexible expansion fitting shall not expand or exert an axial imparting thrust under internal water pressure. The flexible expansion fitting shall not increase or decrease the internal water volume as the unit expands or contracts.
- D. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61.
- E. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.
- F. Joints shall be The Force Balanced FLEX-TEND as manufactured by EBAA Iron, or equal.

#### 2.15 *MARKER TAPE FOR BURIED PIPING*

Not used

#### 2.16 *TRACER WIRE*

Install No. 10 solid-core copper tracer wire

#### 2.17 *CONCRETE FOR THRUST BLOCKS*

- A. As specified in Section 03 30 00 – Cast In Place Concrete. Thrust blocks shall be used only where specifically permitted on the drawings or with pre-approval from the Engineer.

#### 2.18 *JOINT RESTRAINT COUPLINGS*

- A. Mechanical joint restraint coupling shall be of the type that utilizes the follower gland, and shall consist of several individual lug bolts with gripping mechanism that prevents the joints from pulling apart. Glands shall be ductile iron conforming to ASTM A536-80, and dimensions shall be compatible to be used with standard mechanical joint fittings for ductile rim pipe. The mechanical restraint joint shall have a minimum working pressure rating equal to that of the pipe with a safety factor of not less than 2. Restrained joints shall have twist off nuts to insure proper installation of restraining grip mechanism. Mechanical joint restrained coupling shall be EBAA, Iron, Inc. MEGALUG; with Mega-Bond coating.; or approved equal. Coating of gland follower body shall be electrostatically applied and heat cured polyester based powder. Wedge assemblies and bolts shall be coated with heat cured fluoropolymer coatings. Restraints shall be designed for the specific type of pipe to be restrained.

- B. Restrained joint fittings shall meet Uni-B-13 for PVC and be FM and UL approved through 12 inch for both ductile iron and PVC.
- C. Restrained joint fittings for high density polyethylene pipe shall be Victaulic 995 or 997 style coupling.

#### 2.19 FASTENERS

- A. All fasteners shall include washers under both bolt head and nut unless the use of washers is incompatible with the fitting design.
- B. Unless otherwise noted, all bolts, tie rods, and T-bolts used to secure flanges, fittings, and couplings located underground or submerged in liquid shall be Type 304 or 316 stainless steel per ASTM A320 or ASTM A193. Nuts shall be 304 or 316 stainless steel per ASTM A 194 and washers shall be ASTM F436 Type 3.
- C. Unless otherwise noted, all bolts, tie rods, and T-bolts used to secure flanges, fittings, and couplings located indoors, above grade, and in vaults shall be carbon steel conforming to ASTM A307, Grade B with ASTM A563A nuts and ASTM F436 washers. Bolts, nuts, and washers shall be hot dipped galvanized in accordance with ASTM F2329. Stainless steel meeting the requirements of Paragraph B shall also be acceptable.

#### 2.20 INSULATING FLANGE SETS

- A. Insulating flange sets shall be provided where indicated on the plans and shall consist of insulating gaskets, insulating sleeves and washers and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2-inch or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2-inch, insulating sleeves and washers shall be 2-piece and shall be made of polyethylene or phenolic. Steel washers shall comply with ASTM A 325. Insulating gaskets shall be full-face.

### PART 3 EXECUTION

#### 3.1 HANDLING AND DISTRIBUTION OF MATERIALS

- A. Delivery: Handle pipe carefully to ensure delivery at the project site in sound, undamaged condition. Contractor shall replace damaged pipe at no additional expense to the Owner.
- B. Storage: Do not store materials directly on the ground. Adequately support piping to prevent warping. Use protective covers where pipe may be damaged by direct sunlight.
- C. No more than one week's supply of material shall be distributed in advance of pipe laying operations, unless otherwise approved or required.

- D. Before laying, pipe shall be inspected for cracked, broken, or defective pieces. Such pieces shall be rejected. Pipe shall be carefully lowered into the trench to prevent damage. All dirt or other foreign matter shall be removed from inside the pipe before lowering into the trench.

### 3.2 COATING

- A. Unless otherwise indicated in Part 2, all pipe and fittings shall be coated in accordance with specification 09 90 00.

### 3.3 INSTALLATION OF UNDERDRAINS

- A. Perforated pipes shall be laid with the perforations down.

### 3.4 INSTALLATION OF BURIED PRESSURE PIPING

- A. General: Pipe, fittings, and appurtenances shall be installed in accordance with the manufacturer's instructions and in accordance with the following references as appropriate:

1. Ductile Iron Pipe - AWWA C600
2. Polyvinyl Chloride Pipe and HDPE pipe - AWWA C605.
3. Steel Pipe – AWWA C604

- B. Handling: The pipe shall be protected to prevent entrance of foreign materials during laying operations. When laying is not in progress, open pipe ends shall be protected with a watertight plug or other approved means to exclude water or foreign material.

- C. Alignment:

1. Mains shall be installed to the grades and elevations indicated and shall have a minimum cover of 30-inches from the top of the pipe to existing ground or paved surface unless otherwise indicated.
2. The allowable angle of deflection at any joint shall not exceed the amount recommended by the pipe manufacturer for the particular pipe size used. Deviation of any pipe section from the line and grade indicated shall not exceed 1/2-inch.

- D. Joints:

1. Pipe shall be assembled and joined in accordance with the manufacturer's published instructions for the type of pipe and joint used. All portions of the joints shall be thoroughly cleaned before the sections of pipe are assembled. The ends of each pipe shall abut against the next pipe section in such a manner that there shall be no unevenness of any kind along the bottom half of the interior of the pipe. Where mechanical joints are used,

the pipe shall be marked in such a manner that it can be determined after installation that the pipe is properly seated.

2. Where flexible couplings are used as expansion joints, the ends of the pipes shall be separated 1-inch to allow for expansion. The welded seam at the end of each coupled steel pipe shall be ground smooth for approximately 12-inches. Couplings shall be centered on pipe ends. Runs of pipe containing flexible couplings shall be properly blocked, anchored or tied to the structure to prevent joints from separating.
  3. Mechanical restrained joints shall be installed in accordance with joint manufacturer's instructions and recommendation.
- E. Installation of Marker Tape: Install tape in backfill directly over each pipeline, 24 inches over top of pipe, unless shown otherwise on the Plans. Where utilities are buried in a common trench, identify each line by a separate marker tape. Place tapes directly over the applicable line.

### 3.5 *THRUST BLOCKS OR MECHANICAL RESTRAINED JOINTS*

- A. Thrust blocks shall be used only where specifically allowed on the drawings or with prior approval by the Engineer.
- B. Place concrete thrust blocks at all tees, elbows, plugs, and other locations where unbalanced forces exist in underground pipe in accordance with details shown. Place blocks between undisturbed ground and fitting to be anchored. Place blocking so that pipe and fittings will be accessible for repairs. Thrust blocks shall be of such size as to give bearing against undisturbed vertical earth banks sufficient to absorb the thrust from line pressure, allowing a maximum earth bearing pressure of 500 pounds per square foot per foot of depth below natural grade or as shown.
- C. Restrained joint fittings may be used in-lieu of thrust blocks, at the discretion of the Engineer. Contractor shall submit shop drawings showing methods of joint restraint for each type of restrained joint fitting to be used including the length of pipe having restrained push-on joints on all pipes which connect to the restrained fitting.
- D. When it is necessary to restrain push-on joints adjacent to restrained fittings, a harness restraint device shall be used. All harnesses shall have a pressure rating equal to that of the pipe on which it is used. Harness assemblies including tie bolts conform to ASTM A536-80.

### 3.6 *INSTALLATION OF EXPOSED PIPING*

- A. General - Pipe shall be installed as specified, as indicated on the Plans or, in the absence of detail piping arrangement, in a manner acceptable to the Engineer.

- B. Pipe shall be cut from measurements taken at the site and not from the Plans. All necessary provisions shall be taken in laying out piping to provide throughout for expansion and contraction. Piping shall not obstruct openings or passageways. Pipes shall be held free of contact with building construction so as not to transmit noise resulting from expansion.
- C. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, dirt, and other foreign matter when erected. The interior of all lines shall be thoroughly cleaned, to the satisfaction of the Engineer, before being placed in service.
- D. Stuffing box leakage from water sealed pumps shall be contained and not allowed to into storm drains.
- E. Taps for pressure gauge connections on piping and equipment shall be provided with a nipple and a ball type shutoff valve. Drilling and tapping of pipe walls for installation of pressure gauges or switches will not be permitted.
- F. A union shall be provided within 2 feet of each end of threaded end valves unless there are other connections that facilitate easy removal of the valve. Unions shall also be provided in piping at locations adjacent to devices or equipment that may require removal in the future and at locations required by the Plans or other sections of the Specifications.
- G. Provide unions on exposed piping and tubing 3-inches and smaller as follows:
  - 1. At every change in direction (horizontal and vertical).
  - 2. Downstream of valves, 6 to 12 inches.
  - 3. As shown on plans.
- H. In all piping except air piping, insulating fittings shall be provided to prevent contact of dissimilar metals.
- I. Pipe Joints - Pipe joints shall be carefully and neatly made in accordance with the requirements that follow.
  - 1. Threaded - Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be full and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed, after threading and before assembly, to remove all burrs.

Threaded joints in plastic piping shall be made up with Teflon thread tape applied to all male threads. Threaded joints in stainless steel piping shall be made up with Teflon thread sealer and Teflon thread tape applied to all male threads. At the option of the Contractor, threaded joints in other piping may be made up with Teflon thread tape, thread sealer, or a suitable joint

compound. Thread tape and joint compound or sealers shall not be used in threaded joints that are to be seal welded.

Threaded joints in steel piping for chlorine service shall be made up with Teflon thread tape or paste applied to all male threads.

2. Compression - Ends of tubing shall be cut square and all burrs shall be removed. The tubing end shall be fully inserted into the compression fitting and the nut shall be tightened not less than 1-1/4 turns and not more than 1-1/2 turns past finger tight, or as recommended by the fitting manufacturer, to produce a leak tight, torque-free connection.
3. Flared - Ends of annealed copper tubing shall be cut square and all burrs shall be removed prior to flaring. Ends shall be uniformly flared without scratches or grooves. Fittings shall be tightened as required to produce leak tight connections.
4. Soldered and Brazed - Where solder fittings are specified for lines smaller than 2 inches, joints may be soldered or brazed at the option of the Contractor. Joints in 2 inch and larger copper tubing shall be brazed.
5. Flanged - Flange bolts shall be tightened sufficiently to slightly compress the gasket and effect a seal, but not so tight as to fracture or distort the flanges. A plain washer shall be installed under the head and nut of bolts connecting plastic pipe flanges. Anti-seize thread lubricant shall be applied to the threaded portion of all stainless steel bolts during assembly. Connecting flanges shall have similar facings, i.e., flat or raised face.
6. Welded - Welding shall conform to the specifications and recommendations contained in the "Code for Pressure Piping", ANSI B31.1.
7. Grooved Couplings - Grooves for grooved couplings shall be cut with a specially designed grooving tool. Grooves cut in steel pipe shall conform to flexible grooving dimensions as set forth in AWWA C606, and shall be clean and sharp without burrs or check marks.

### 3.7 ACCEPTANCE TESTS AND INSPECTION FOR GRAVITY PIPING

#### A. General.

1. All testing and inspection shall be performed after final backfill and compaction operations are complete. If the Contractor so desires, he may pretest the lines at his own expense, but final testing must be performed after compaction requirements have been approved.
2. If any of the tests or inspections covered in this section indicates that sewers require repair, then after repairs are complete, all testing and inspection shall be performed again. The cost of any retests, including time for the

Engineer, shall be borne by the Contractor at no additional cost to the project.

3. Prior to testing, all lines shall be thoroughly cleaned by flushing, and shall have passed a Wayne ball of appropriate size. Contractor is to submit to the Engineer a detailed procedure on protecting the existing sewer system from contaminants during the flushing operation.

B. Mandrel

1. All sections of completed gravity pipe main lines shall be tested to assure that no potential obstructions are present in the lines. A rigid mandrel with a circular cross section having a diameter not less than 95% of the specified pipe diameter shall pass through the pipe without resistance.

C. Low-Pressure Air Test

1. Supply air to the test section slowly. A constant pressure of 3.5 psig shall be reached and maintain internal pressure of at least 3.0 psig for at least five (5) minutes.
2. After the stabilization period, disconnect the air supply. A pressure loss of 0.5 psig is used to compute the allowable pressure loss using the following formula.
3. The minimum allowable time in minutes for such a pressure drop is determined from the formula  $T_{\min} = 0.000183D^2L$ , where:
  - a.  $D$  = Nominal inside diameter of pipe (inches)
  - b.  $L$  = Length of pipe test section (feet)
4. Regardless of the formula, the minimum time allowed for pressure drop shall be eight (8) minutes.
5. The pressure gage for monitoring the air pressure shall have a minimum division of 0.10 psi increments.
6. A valid test is when the air pressure is released from the opposite end of the inlet air entry connection with an air release apparatus outlet connection.
7. Adjustment of Pressure for Groundwater. Should the pipe section being tested lie below the local groundwater table, the test pressures shall be raised in proportion to the depth of the centerline of the pipe below the water table. Additional pressure (beyond the 3.5 psig specified above) shall be added at the rate of 0.433 psig per foot of depth below groundwater.

D. Video



1. Video inspection shall be performed on all new sewer mains. Video inspections shall be paid for by the Contractor and shall be completed prior to the final acceptance of the improvements.
2. The inspection shall be in color, and shall be recorded on VHS-format 1/2" tape or DVD, which shall become the property of the Owner.
3. The Engineer shall be the sole judge as to the acceptability of construction revealed by such inspection.
4. Within 24 hours prior to testing, all lines shall be thoroughly flushed with water to assist camera in the identification of low areas.

### 3.8 ACCEPTANCE TESTS FOR BURIED PRESSURE PIPING

#### A. General.

1. All testing and inspection shall be performed after final backfill and compaction operations are complete. If the Contractor so desires, he may pretest the lines at his own expense, but final testing must be performed after compaction requirements have been approved.

#### B. In general, tests shall be conducted in accordance with AWWA C600 and C651 except as otherwise herein specified.

#### C. All newly installed sections of buried pressure piping shall be pressure and leakage tested as described herein.

1. For buried pressure pipelines, tests shall be made on two or more valved sections not to exceed 2,500 feet in length. The Contractor shall furnish all necessary equipment, material and labor required.
2. Tests shall be made after the trench has been backfilled and compacted, but not until at least 5 days have elapsed since any thrust blocks in the section have been poured.
3. The pipe shall be slowly filled with water and ensuring all air expelled from section being tested. The line shall stand full of water for at least twenty-four hours prior to testing to allow all air to escape. A test pressure equal to 1.5 times the design pressure, of the pipe measured at the point of lowest elevation pressure, or 100 psi, whichever is greater, shall be applied.
4. The test pressure in the line shall be maintained for a period of 2 hours. Test pressure shall be maintained within 5 psi during the test period. Conduct a leakage test concurrently with the pressure test. Leakage is defined as the volume of water that must be supplied into the newly laid pipeline to maintain pressure within +/- 5 psi of the test pressure after it is filled and purged of air. The water required to maintain test pressure shall

be measured by means of a graduated barrel, drum, or similar device at the pump suction or through a meter.

Allowable leakage at the specified test pressure shall not exceed the amounts allowed by AWWA C600,  $L = \frac{SD\sqrt{P}}{148,000}$

Where:

L = Testing allowance in gallon per hour.

S = Length of pipe tested in feet.

D = Nominal diameter of the pipe in inches.

P = Average test pressure during the hydrostatic test, in pounds per sq. inch.

Hydrostatic testing allowance per 1,000 ft. of pipeline in gph.

PSI	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
200	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29
175	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15
150	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99
125	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81
100	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62

5. Should testing disclose any visible leaks or leakage greater than that allowed, the defective joints or pipe shall be located, repaired, and re-tested until satisfactory. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project.

### 3.9 ACCEPTANCE TEST FOR EXPOSED PIPING

- A. Pipe to be Tested - All new installed piping sections shall be pressure and leakage tested as specified herein.

- B. Pressure Testing - After the section of line to be tested has been filled with water or other test media, the test pressure shall be applied and maintained without interruption for 2 hours plus any additional time required for the Engineer to examine all piping undergoing the test and for the Contractor to locate all defective joints and materials.
1. Test medium shall be potable water for potable water piping; all other piping may be tested using plant water subject to Engineer's approval.
  2. Pipe system shall be tested at 1-1/2 times the operating pressure, or 100 psi, whichever is greater, using the appropriate test fluid medium.
  3. All piping shall be tight and free from leaks. All pipe, fittings, valves, pipe joints, and other materials that are found to be defective shall be removed and repaired or replaced with new and acceptable material, and the affected portion of the piping be retested until satisfactory. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project.

Compressed air or gas under pressure shall not be used to test plastic piping unless specifically recommended by the pipe manufacturer.

Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method acceptable to the Engineer. All fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the specified test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.

**END OF SECTION**

## **SECTION 40 05 60**

### **AIR-RELEASE AND VACUUM-RELIEF VALVES**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. This section includes materials and installation of air and vacuum valves, air-release valves, combination air-release valves, slow-closing air and vacuum valves, vacuum-relief valves, and slow-closing combination air-release valves for water and sewage service.

##### **1.2 RELATED WORK**

- A. Section 09 90 00 – Painting and Coating (Site Work)
- B. Section 33 01 00 – Piping and Fittings
- C. Section 33 13 00 – Disinfection of Water System

##### **1.3 REFERENCES**

- A. American Society of Mechanical Engineers (ASME)
- B. American Society for Testing and Materials (ASTM)
- C. American Water Works Association (AWWA)
- D. Food and Drug Administration (FDA)
- E. National Electrical Manufacturers Association (NEMA)
- F. Occupational Safety & Health Administration (OSHA)

##### **1.4 SUBMITTALS**

- A. Submittals shall be in accordance with the General Provisions.
- B. As specified in Section 01 33 00 – Submittal Procedures
- C. Submit manufacturer's catalog data and detail drawings showing all valve parts and described by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show linings and coatings.

## **PART 2 PRODUCTS**

### **2.1 VALVE IDENTIFICATION**

- A. Valves are identified in the drawings by size, category and type number. For example, a callout in the drawings of a 3/4" Type 1 Air Release Valve refers to a Type 1 Air Release Valve in these specifications, which is a 150-psi 3/4" or smaller air-release valve.

### **2.2 BOLTS, NUTS, AND GASKETS FOR FLANGED VALVES**

- A. See Section 33 01 00 and specification for the pipe to which the valve is attached.

### **2.3 VALVE DESIGN-AND OPERATION**

- A. Valve design shall comply with AWWA C512, except as modified herein. Class 150 valves shall have a maximum working pressure of at least 150 psi.
- B. Air-Release Valves for Water Service:
  - 1. Air-release valves for water service 3/4 inch and smaller shall be of the direct-acting type or lever type. Valves larger than 3/4 inch shall have a float-actuated compound lever with linkage mechanism to release air.
  - 2. Air-release valves of sizes 1 and 2 inches shall incorporate a body with flanged top cover and replaceable orifice and a synthetic rubber needle or disc actuated by the float and linkage mechanism. Top cover shall include a 1/2-inch threaded port with bronze plug. Body shall include a 1/2-inch threaded drain port near the bottom with a bronze plug.
- C. Air and Vacuum Valves for Water Service:
  - 1. Air and vacuum valves for water service shall have a body with a flanged top containing the air-release orifice. The float shall rise with the water level in the valve body to close the orifice by sealing against a synthetic rubber seat.
  - 2. Air and vacuum valves 3 inches and smaller shall have 1/2-inch threaded ports with bronze plugs in the top cover and near the bottom of the valve body. Air and vacuum valves larger than 3 inches shall have a 1-inch threaded drain outlet with bronze plug near the bottom of the valve body and a 1-inch threaded port with bronze plug on the side of the valve body above the minimum water level in the valve which forces the float against the valve seat.
- D. Combination air valves 3 inches and smaller shall have a float with lever arm to actuate a poppet valve. A needle shall be attached to the float arm. The poppet valve shall serve to admit large quantities of air when the pipeline drains. The

needle shall serve to release small quantities of air as the pipeline fills or as air accumulates in the pipeline.

Combination air valves 4 inches and larger for water service shall consist of an air and vacuum valve with an air-release valve attached to it or integral with it. Connect the attached air-release valve to the air and vacuum valve with standard weight steel piping (ASME B36.10) and an isolation valve if required.

- E. Slow-closing air and vacuum valves for water service shall have a float assembly and large venting orifice to exhaust large quantities of air from pipelines when being filled and to admit large quantities of air when pipelines are being drained. Valve assembly shall incorporate a perforated water diffuser or surge check valve on the inlet to prevent the water column entering the valve from slamming the float shut.
- F. Slow-closing combination air valves for water service shall consist of an air and vacuum valve with an air-release valve integral or attached to it. The air and vacuum valve shall incorporate a perforated water diffuser or surge check valve on the inlet to prevent the water column from slamming the float shut. Connect the attached air-release valve to the air and vacuum valve with standard weight steel piping (ASME B36.10) and an isolation valve if required.
- G. Air and Vacuum Valves for Vertical Turbine Pump Service:
  - 1. Air and vacuum valves for vertical turbine pump service (3 inches and smaller) shall have a float assembly. The discharge orifice shall have a double-acting throttling device to restrict air venting; it shall fully open to allow unrestricted air entry when the pump is shut down. Valve shall have a body with flanged top containing the air-release orifice. The float shall rise with the water level in the valve body to close the orifice by sealing against a synthetic rubber seat.
  - 2. Valves 3 inches and smaller shall include the following features:
    - a. Water diffuser around the float to break up the incoming water column before contacting the float.
    - b. Double-acting throttling device that restricts airflow when the pump is started and opens fully when the pump is stopped.
- H. Air-release valves and air and vacuum valves for sewage service shall have elongated cylindrical chambers designed to release entrained air and sewage gases through an air-release orifice. The valve body and float shall withstand a 500 psig shell pressure. Provide:
  - 1. 1/2-inch clearance around the float in the chamber.
  - 2. Minimum size 1/2-inch isolation valve, quick disconnect coupling, and backflushing hose.

3. Blowoff port and valve at the bottom of the chamber.
- I. Combination Sewage Air Valves: Combination sewage air valves shall vent accumulating gases during system operation through one orifice and shall allow large volumes of air to enter or escape the pipeline during filling operations through a second orifice. Valves shall have elongated cylindrical chambers designed to release entrained air and sewage gases through two air-release orifices. The valve body and float shall withstand a 500 psig shell pressure. The same general requirements shall apply as specified for air and vacuum valves. Provide:
    1. 1/2-inch clearance around the float in the chamber.
    2. Minimum size 1/2-inch isolation valve, quick disconnect coupling, and backflushing hose.
    3. Blowoff port and valve at the bottom of the chamber.
    4. Each sewage air valve shall be furnished with the following backwash accessories, fully assembled on the valve:
      - a. Inlet shutoff valve.
      - b. Flush valve.
      - c. Clear water inlet valve.
      - d. Rubber supply hose.
      - e. Quick disconnect couplings.

#### 2.4 MATERIALS OF CONSTRUCTION

- A. Materials of construction for air-release, air and vacuum, and combination air valves for water service shall be as follows:

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 Arsenic Compliance Project  
 Well 3 Water Treatment Improvements

<b>Item</b>	<b>Material</b>	<b>Specification</b>
Body and cover	Cast iron	ASTM A48, Class 35; or ASTM A126, Class B
Float, lever or linkage, air-release mechanism, poppet, guide rod, guide bushings, fasteners, other internal metal parts	Stainless steel	AISI Type 304
Plugs	Bronze	See paragraph E below
Seat, plunger, needle	Buna-N	—

- B. Materials of construction for diffusers or surge check valves for slow-closing air and vacuum valves shall be as follows:

<b>Item</b>	<b>Material</b>	<b>Specification</b>
Body	Cast iron	ASTM A48, Class 30 or ASTM A126, Class B
Seat, plug, bushing	Bronze	See paragraph E below
Spring, retaining ring, seat retaining ball, fasteners, other internal metal parts	Stainless steel	AISI Type 304
Gasket between diffuser or surge check valve and valve	Cloth-inserted rubber, 1/8 inch thick	Crane Co., Style 777 or equal

- C. Materials of construction for air-release, air and vacuum valves, and combination air valves for sewage service shall be as follows:

<b>Item</b>	<b>Material</b>	<b>Specification</b>
Body, cover, baffle	Cast iron	ASTM A48, Class 35 or ASTM A126, Class B
	Stainless steel	AISI Type 316
Float plug, float guide, stems, fasteners, internal parts	Stainless steel	AISI Type 316
Seat, plunger, needle	Buna-N	—



- D. Materials of construction for vacuum-relief valves for pipes and tanks shall be as follows:

Item	Material	Specification
Body	Cast iron	ASTM A126, Class B
Plug	Bronze	ASTM B584, Alloy C83600
Hood	Steel	AISI 1020
Seat	Buna-N	–
Spring	Stainless steel	ASTM A313, Type 302
Seat retaining screws, ring plate bolts and nuts, hood retaining screws, hood washers, other internal metal parts	Stainless steel	AISI Type 304

- E. Rubber seats shall be made of a rubber compound that is resistant to free chlorine and monochloramine concentrations up to 10 mg/L in the fluid conveyed.
- F. Body and cover bolts, nuts, and cap screws shall be carbon steel, ASTM A307.

## 2.5 VALVE END CONNECTIONS

- A. Valves 3 inches and smaller shall have threaded ends. Valves 4 inches and larger shall have flanged ends.
- B. Flanges for Class 150 valves shall comply with ASME B16.1, Class 125. Threaded ends shall comply with ASME B1.20.1.

## 2.6 VALVES

### A. Air Release Valves

1. Type 1--Air-Release Valves, 3/4 Inch and Smaller: Valves shall have an operating pressure of 150 psi. Orifice sizes shall be 3/32 or 1/8 inch for 1/2-inch valves and 1/8 inch for 3/4-inch valves. Valves shall be APCO Series 50; Val-Matic Model 15A Series or equal.
2. Type 2--Air-Release Valves, 1 and 2 Inches, Class 150: Valves shall have a maximum working pressure of 150 psi. Orifice size shall be 3/16 or 1/4 inch. Valves shall be APCO Series 50, Val-Matic Model 15A Series or equal.
3. Type 3--Sewage Air-Release Valves, 2 Through 4 Inches, Class 150: After entraining air escapes through the orifice, the orifice shall be closed by a needle on a compound lever mechanism to prevent the escape of sewage. The orifice shall remain closed until more gas accumulates and the cycle automatically repeats. Valve shall seat to prevent sewage from leaking

through the valve at any pressure. Valves shall have an operating pressure of at least 150 psi. Valves shall be APCO Model 400, Val-Matic Model 48 and 49 Series, or equal.

B. Air and Vacuum Valves

1. Type 1--Air and Vacuum Valves, ½" Through 4 Inches, Class 150: Valves shall be APCO Series 141, Val-Matic Model 100S Series or equal.
2. Type 2--Air and Vacuum Valves for Vertical Turbine Pump Service, 6 Inches and Smaller: Valves shall be APCO Series 140DAT or Series 1900, Val-Matic Model 100ST and 106 SS Series or equal. Valve shall incorporate an air-release valve, Type 1.
3. Type 3--Slow-Closing Air and Vacuum Valves, 4 Through 16 Inches, Class 150: Valves shall be APCO Series 1900, Val-Matic Surge Suppression Air Valves, or equal.
4. Type 4--Sewage Air/Vacuum Valves, 2 Through 12 Inches, Class 150: Valve shall allow unrestricted venting or reentry of air during filling or draining of pipelines. Valve shall incorporate two floats, or a float and a plug connected by a common float guide, to maintain an air gap between the two. Top float or plug shall rest against the orifice seat while the valve chamber contains liquid. Valve shall seat to prevent sewage from leaking through the valve at any pressure. Valves shall be APCO Series 401, Val-Matic Model 301 Series, or equal.

C. Combination Air Valves

1. Type 1--Combination Air Valves, 1 Through 4 Inches, Class 150: Minimum orifice size for the air-release valve shall be 3/16 inch. Combination air-release valves shall be APCO Series 143C, Val-Matic Model 201C Series or
2. Type 2--Slow-Closing Combination Air Valves, 4 Through 16 Inches, Class 150: Minimum orifice size for air-release valve shall be 1/4 or 3/16 inch. Combination air-release valves shall be APCO Series 1700, Val-Matic Surge Suppression Dual Body Air Valves, or equal.
3. Type 3--Sewage Combination Air Valves, 1 Through 4 Inches, Class 150: Valve system shall allow unrestricted venting or reentry of air during filling or draining of pipelines and to vent small pockets of air which collect in the pipeline. Valve shall seat to prevent sewage from leaking through the valve at any pressure. Valves shall be APCO Series 440 or equal.

D. Vacuum-Relief Valves

1. Type 1--Vacuum-Relief Valves for Pipes and Tanks, 3 Through 12 Inches, Class 150: Vacuum-relief valves shall be capable of allowing air into pipes and tanks while they are being drained. Valve shall be globe-body style with

flanged end per ASME B16.1, Class 125. Pressure rating shall be at least 150 psi. Provide a spring-loaded plug which is normally closed and which opens to allow air to enter. Plug shall be center-guided at both ends and shall be normally closed by means of a spring and shall open when the vacuum or differential pressure exceeds 0.25 psi. Valves shall be APCO Model S1500, Val-Matic Model 1800VB Series or equal.

## **PART 3 EXECUTION**

### **3.1 SERVICE CONDITIONS**

- A. Valves shall seat driptight at the specified seating pressure.

### **3.2 FACTORY TESTING**

- A. Test each valve per AWWA C512, Section 5 and the following.
- B. Hydrostatically test the pressure-containing parts at the factory with water for 30 minutes minimum at a pressure of 1.5 times the rated pressure but not less than 20 psig. Test shall show zero leakage. If leaks are observed, repair the valve and retest. If dismantling is necessary to correct valve deficiencies, provide an additional operational test per AWWA C512, Section 5 for each affected valve.
- C. The chloride content of liquids used to test austenitic stainless steel materials shall not exceed 50 ppm. To prevent deposition of chlorides as a result of evaporative drying, remove residual liquid from tested parts at the conclusion of the test.

### **3.3 PAINTING AND COATING**

- A. Coat cast-iron valves the same as the adjacent piping. If the adjacent piping is not coated, then coat per Section 09 90 00. Apply the specified prime and intermediate coats at the place of manufacture. Finish coat shall match the color of the adjacent piping.
- B. Coat interior surfaces of cast-iron valves at the place of manufacture per Section 09 90 00. Do not coat seating areas and plastic, bronze, stainless steel, or other high alloy parts.
- C. Alternatively, line and coat valves with fusion-bonded epoxy. Do not coat seating areas and plastic, bronze, stainless steel, or other high alloy parts.

### **3.4 SHIPMENT AND STORAGE**

- A. Identify the equipment with item and serial numbers and pipeline station. Material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number and project equipment pipeline station or the equipment for which it is intended. In addition, ship crated equipment with duplicate packing lists, one inside and one on the outside of the shipping container.

- B. Pack and ship one copy of the manufacturer's standard installation instructions with the equipment. Provide the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite and before start-up.
- C. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Provide closures at the place of pump manufacture prior to shipping. For studed openings, use all the nuts needed for the intended service to secure closures.
- D. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Provide caps or plugs at the place of pump manufacture prior to shipping.
- E. Clearly identify lifting points and lifting lugs on the valves. Identify the recommended lifting arrangement on boxed equipment.

### 3.5 *INSTALLATION*

- A. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.
- B. Clean threaded joints by wire brushing or swabbing. Apply Teflon® joint compound or Teflon® tape to pipe threads before installing threaded valves. Joints shall be watertight.
- C. Do not use duct tape and plastic for covering the ends of pipe flanges. Use a solid metal cover with rubber gasket to cover flange openings during installation. These metal covers shall remain in place until the piping is connected to the valves.
- D. Do not spring flanges of connecting piping into position. Separately work connecting piping systems into position to bring the piping flanges into alignment with the matching valve flanges. Do not move valves to achieve piping alignment. Do not use electrical heating stress relieving to achieve piping alignment.
- E. Line up pipe flange bolt holes with valve nozzle bolt holes within 1/16 inch maximum offset from the center of the bolt hole to permit insertion of bolts without applying any external force to the piping.
- F. Flange face separation shall be within the gasket spacing  $\pm 1/16$  inch. Use only one gasket per flanged connection.

### 3.6 *VALVE FIELD PRESSURE TESTING*

- A. Test valves at the same time that the connecting pipelines are pressure tested. See Section 33 01 00 for pressure testing requirements. Protect or isolate any

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parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the test pressure.

**END OF SECTION**

## **SECTION 40 07 75**

### **PIPING AND EQUIPMENT IDENTIFICATION**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. This section includes furnishing and installing markers, labels, tags, and signs for piping, valves, and equipment.

##### **1.2 RELATED WORK**

- A. Section 09 90 00 – Painting and Coating (Site Work)
- B. Section 40 05 00 – Piping and Fittings
- C. Section 40 05 23 – Valves

##### **1.3 REFERENCES**

- A. American Society of Mechanical Engineers (ASME) A13.1
- B. American Society for Testing and Materials (ASTM)
- C. American Water Works Association (AWWA)

##### **1.4 SUBMITTALS**

- A. Submittals shall be in accordance with the General Provisions and Section 01 33 00 – Submittal Procedures.
- B. Submit list of wording, symbols, letter size, and color coding for all identification.
- C. Provide manufacturers catalog literature for each product required.
- D. Submit two samples of each product to be used.
- E. Submit manufacturer's installation instructions.

#### **PART 2 PRODUCTS**

##### **2.1 MANUFACTURERS**

- A. Identification shall be by Brady Corporation, Seton, or equal.

## 2.2 VALVE TAGS

- A. Valve tags shall be brass or stainless steel. Plastic tags will not be accepted.
- B. Tags shall be 40 mils thick and shall include filled text for easy readability.
- C. Lettering shall be stamped letters with character size and words to ANSI A13.1.
- D. Valve tags shall be attached using stainless steel beaded chain, jack chain or wire. Nylon ties will not be accepted.

## 2.3 PIPE MARKERS

- A. Pipe markers shall include the service name and flow directional arrows. Labeling shall conform to ASME A13.1.
- B. Locate pipe markers at maximum 20 foot centers on straight runs including risers and drops, adjacent to each valve and tee, and at each side of penetration of structure or enclosure.
- C. Labels for indoor locations shall be mechanically fastened or self-adhesive vinyl.
- D. Labels for outdoor locations shall be UV resistant acrylic plastic
- E. Snap-on type markers made of UV resistant acrylic will be accepted for both indoor and outdoor use.
- F. Markers attached with nylon ties will not be accepted.

## 2.4 MECHANICAL EQUIPMENT

- A. Label all mechanical equipment with the equipment description and tag number shown on the drawings.
- B. Labels shall be a minimum of 1-1/2 inches by 4 inches in size and shall be fabricated of aluminum or fiberglass resistant to UV.

## 2.5 HAZARDOUS MATERIALS WARNING SIGNS

- A. Label all chemical storage tanks and entrances to areas containing chemicals with “diamond” warning signs complying with NFPA 704. Size shall be a minimum of 10-inch square
- B. Install 1/8-inch fiberglass wall signs (Brady B-120 or equal). Signs attached to tanks shall be self-adhesive (Brady B-946 or equal).

## 2.6 AUTOMATIC EQUIPMENT

- A. Install automatic start warning signs adjacent to the following equipment. The signs shall include the wording “AUTOMATIC EQUIPMENT – MAY START AT

ANY TIME”.

Well pump
Chemical enclosure entrances
Backwash supply pump
Backwash recycle pump
High service pumping station

## 2.7 NO SMOKING SIGNS

- A. Install “NO SMOKING” sign at the following locations. Sign shall be weather and UV resistant fiberglass with a minimum size of 10 inches by 7 inches.

Chemical enclosure entrances
Standby generator

## 2.8 UNDERGROUND MARKERS

- A. Non-Detectable Underground Markers

1. Material: Polyester
2. Thickness: 0.09 mm thick to ASTM D1593
3. Width: 6 inches
4. Tensile Strength: 7 lb/in to ASTM D638
5. Elongation: 300% to ASTM D638
6. Color to American Public Works Association standards

- B. Detectable Underground Markers

Install No. 10 solid-core copper tracer wire



### **PART 3 EXECUTION**

#### **3.1 *INSTALLATION OF LABELS AND TAGS***

- A. Install all tags, signs, and labels in clear view. Pipe markers shall be aligned with axis of pipe.
- B. Degrease and clean surfaces to receive adhesive labels prior to application.
- C. Install valve tags with corrosion resistant ties to the valve handwheel. Valves in main and branch piping shall be tagged.

#### **3.2 *INSTALLATION OF WARNING TAPE***

- A. Bury non-detectable tape 12 to 18 inches below ground level, directly over the utility it identifies.
- B. Bury No. 12 tracer wire 4 to 6 inches below ground level directly over the utility it identifies.

**END OF SECTION**

## **SECTION 40 20 10**

### **PIPE SUPPORTS**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. All pipe hangers, brackets, supports and accessories for newly installed piping as specified and indicated in the Contract Documents.
- B. All labor, materials, equipment and incidentals necessary and required for their completion.
- C. Concrete and fabricated steel supports shall be as indicated or specified in other sections or, in the absence of such requirements, as permitted by the Engineer.

##### **1.2 RELATED WORK**

- A. Section 03 30 00 - Cast-in-Place Concrete
- B. Section 09 90 00 – Painting and Coating (Site Work)
- C. Section 40 05 23 – Valves & Appurtenances

##### **1.3 REFERENCES**

- A. Seismic design requirements in applicable codes and regulations.

##### **1.4 QUALITY ASSURANCE**

- A. Except as modified or supplemented herein, all pipe supports shall comply with the applicable provisions of ANSI/MSS SP-58 AND MSS SP-69.
- B. In certain locations, pipe supports, anchors, and expansion joints have been indicated on the drawings, but no attempt has been made to indicate every pipe support, anchor, and expansion joint. It shall be the Contractor's responsibility to provide a complete system of pipe supports, to provide expansion joints, and to anchor all piping, in accordance with the requirements set forth herein. Additional pipe supports may be required adjacent to expansion joints, couplings, or valves.

##### **1.5 SUBMITTALS**

- A. As specified in Section 01 33 00 – Submittal Procedures
- B. Data shall include a listing of the intended use and general location of each item submitted.

## 1.6 *DELIVERY, STORAGE AND HANDLING*

- A. All pipe support materials shall be packaged as necessary to ensure delivery in satisfactory condition.

## **PART 2 PRODUCTS**

### 2.1 *MATERIALS*

- A. Unless otherwise specified or indicated on the drawings, pipe supports shall be fabricated of manufacturer's standard materials and provided with manufacturer's standard finish.
- B. Pipe support types and application shall comply with Schedule I in paragraph 3.2.

### 2.2 *PERFORMANCE AND DESIGN REQUIREMENTS*

#### A. Design Criteria

1. Pipe supports shall be manufactured for the size and type of pipe to which they are applied. Strap hangers will not be acceptable. Threaded rods shall have sufficient threading to permit the maximum adjustment available in the support item.
2. All piping shall be rigidly supported and anchored so that there is no movement or visible sagging between supports.
3. Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead ending. Anchors shall be located as required to force expansion and contraction movement to occur at expansion joints, loops or elbows, and as required to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints. Pipe supports shall be designed to comply with the applicable seismic requirements in accordance with the seismic design requirements section.

### 2.3 *DIMENSIONS*

- A. Unless closer spacing is indicated on the drawings, the maximum spacing for pipe supports and expansion joints shall be as scheduled in Schedule II at the end of this section.

### 2.4 *STRUCTURAL DESIGN*

- A. Design loads for inserts, brackets, clamps, and other support items shall not exceed the manufacturer's recommended loads.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- A. Approved anchors shall be used to fasten supports to concrete or masonry. Unless otherwise indicated on the drawings or permitted by the Engineer, piping shall be supported so that the closest distance from pipe wall or insulation covering is at least 1-1/2 inches from the face of walls and at least 3 inches below ceilings.
- B. Contact between dissimilar metals, including contact between stainless steel and carbon steel, shall be prevented. Those portions of pipe supports which contact dissimilar metals shall be rubber or vinyl coated.

**3.2 SCHEDULES**

- A. SCHEDULE I: Pipe Support Types and Application Schedule:

<u>Description or Location</u>	<u>MSS SP-69</u> (Note 1)	<u>Other</u>
<u>Hangers</u>		
2-1/2 inch and smaller pipe:		
J-style	5	Elcen "90", Fee & Mason "210", Unistrut "J Hangers", or equal.
clevis	1	Elcen "12B", Fee & Mason "105", ITT Grinnell "65", or equal.
3-inch through 10-inch pipe:		
clevis	1	Elcen "12", Fee & Mason "239", ITT Grinnell "260" for steel pipe; Elcen "12C", Fee & Mason "104", ITT Grinnell "590" for cast iron pipe, or equal.
<u>Concrete Inserts, steel:</u>		
12-inch and smaller pipe		
	18	Channel 12 ga, galv. 1-5/8" x 1-3/8", min. 8 inches long, anchor lugs on 4" centers, at least three lugs, end caps, and filler strip.
<u>Wall Supports and Frames, steel :</u>		
12-inch and smaller pipe:		
brackets	32, 33	---
prefabricated channels	---	12 ga galv., 1-5/8" x 1-5/8", with suitable brackets and pipe clamps.

<u>Description or Location</u>	<u>MSS SP-69</u> (Note 1)	<u>Other</u>
offset pipe clamp, (1-1/2 inch and smaller pipe)	---	Galv., 1-1/4" x 3/16" steel with 3/8" bolts.
offset pipe clamp, (2-inch to 3-1/2 inch pipe)	---	Galv., 1-1/4" x 1/4" steel, with 3/8" bolts.
<u>Floor Supports</u> , steel or cast iron:		
6-inch and small pipe	37 with base	---
8-inch through 24-inch pipe	38 with base	--

B. SCHEDULE II: Spacing Schedule

- Distance between supports shall not be more than that recommended by the pipe manufacturer.
- Distance between supports shall not be more than that shown on the drawings.
- Additional supports shall be added as required to prevent visible bowing of pipe.
- In addition to the spacing requirements listed above, the distance between supports shall not be more than listed in the following schedule.

Type of Pipe	Pipe Support Max Spacing, ft	Max Run Without Expansion Joint, Loop. or Bend, ft	Expansion Joint Max Spacing, ft	Type of Expansion Joint
Ductile Iron, 4" and larger	15	80	80	Note 1
Steel for all services:				
1-1/4 inch and smaller	7	30	100	Note 1
1-1/2 to 4 inch	10	30	100	Note 1
Over 4 inch	15	80	80	Note 1

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Type of Pipe	Pipe Support Max Spacing, ft	Max Run Without Expansion Joint, Loop. or Bend, ft	Expansion Joint Max Spacing, ft	Type of Expansion Joint
PVC, Schedule 40				
Smaller than 3"	4	20	60	Note 1
3" and larger	6	20	60	Note 1
PVC Schedule 80				
Smaller than 3"	5	20	60	Note 1
3" and larger	7	20	60	Note 1

**Notes:**

1. Expansion joint not required in straight run of pipe if overall length does not exceed the maximum run specified in schedule.

**END OF SECTION**

**SECTION 40 20 90**  
**PVC AND CPVC PROCESS AND CHEMICAL PIPING**

**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- A. This section includes materials, installation, and testing of PVC and CPVC piping smaller than 4 inches used in process piping and chemical piping.

**1.2 RELATED WORK**

- A. Section 22 40 10 – Plumbing Specialties (Site Work)
- B. Section 33 13 00 – Disinfection of Water System
- C. Section 40 05 00 – Pipe and Fittings
- D. Section 40 05 23 – Valves and Appurtenances
- E. Section 40 20 10 – Pipe Supports
- F. Section 40 24 68 – PVC Secondary Containment Piping

**1.3 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
- B. American Water Works Association (AWWA)

**1.4 SUBMITTALS**

- A. Submit shop drawings in accordance with Section 01 33 00 – Submittals.
- B. Submit materials description for pipe and fittings with ASTM reference and grade and manufacturer's certification of compliance with referenced standards.
- C. Submit wall thickness and pressure rating of pipe and fittings.

**PART 2 PRODUCTS**

**2.1 PVC PIPE**

- A. The material used in the manufacture of the pipe shall be domestically produced rigid polyvinyl chloride (PVC) compound, Type I Grade I, with a Cell Classification of 12454 as defined in ASTM D1784, trade name designation H707 PVC. This compound shall be gray in color as specified, and shall be approved by ANSI/NSF International for use with potable water (NSF Std 61).

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- B. PVC pipe shall be manufactured in strict accordance to the requirements of ASTM D1785 for physical dimensions and tolerances. Each production run of pipe manufactured in compliance to this standard, shall also meet or exceed the test requirements for materials, workmanship, burst pressure, flattening, and extrusion quality defined in ASTM D1785. All belled-end pipe shall have tapered sockets to create an interference-type fit, which meet or exceed the dimensional requirements and the minimum socket length for pressure-type sockets as defined in ASTM D2672. All PVC Schedule 80 pipe must also meet the requirements of NSF Standard 14 and CSA Standard B137.3 rigid PVC pipe for pressure applications, and shall bear the mark of these Listing agencies. This pipe shall have a flame spread rating of 0-25 when tested for surface burning characteristics in accordance with CAN/ULC-S102-2-M88 or equivalent.
- C. Product marking shall meet the requirements of ASTM D1785 and shall include: the manufacturer's name (or the manufacturer's trademark when privately labeled); the nominal pipe size; the material designation code; the pipe schedule and pressure rating in psi for water @ 73°F; the ASTM D1785; the independent laboratory's seal of approval for potable water usage; and the date and time of manufacture.

## 2.2 CPVC PIPE

- A. The material used in the manufacture of the pipe shall be a rigid chlorinated polyvinyl chloride (CPVC) compound, Type IV Grade I, with a Cell Classification of 23447 as defined in ASTM D1784. This compound shall be light gray in color, and shall be approved by NSF for use with potable water. Material used shall be domestically produced CPVC material as provided by Noveon, Inc. (formerly the BFGoodrich Company), or approved equal.
- B. CPVC Schedule 40 and Schedule 80 pipe shall be manufactured in accordance to the requirements of ASTM F441 for physical dimensions and tolerances. Each production run of pipe manufactured in compliance to this standard, shall also meet the test requirements for materials, workmanship, burst pressure, flattening, and extrusion quality defined in ASTM F441. All belled-end pipe shall have tapered sockets to create an interference-type fit, which meet or exceed the dimensional requirements, and the minimum socket length for pressure-type sockets, as defined in ASTM D2672.
- C. Product marking shall meet the requirements of ASTM F441 and shall include: the manufacturers name (or the manufacturers trademark when privately labeled); the nominal pipe size; the material designation code; the pipe schedule and pressure rating in psi for water @ 73°F; the ASTM F441; and the independent laboratory's seal of approval for potable water usage. Marking shall also include the flame spread rating and smoke development rating when tested and listed for surface burning characteristics per CAN/ULC S102.2 (Flame Spread (F.S.) of <25 and Smoke Development (S.D.) of <50).

## 2.3 FITTINGS

- A. PVC fittings shall be schedule 80 grey, socket-type fabricated of ASTM D1784, Type I, Grade 1 conforming to ASTM D2467.



- B. CPVC fittings shall be schedule 80 grey, socket-type fabricated of ASTM D1784, Type IV, Grade 1 conforming to ASTM F439.

## 2.4 JOINTS

- A. All joints shall be solvent welded or union unless flanged connections are required for adjacent equipment.
- B. All solvent cements used for PVC, except for pipes carrying sodium hypochlorite and sodium hydroxide shall conform to ASTM D2564 and be listed by ANSI/NSF for potable use applications.
- C. All solvent cements used for CPVC, except for pipes carrying sodium hypochlorite and sodium hydroxide shall conform to ASTM F493 and be listed by ANSI/NSF for potable use applications.
- D. Solvent cement for pipes carrying sodium hypochlorite or sodium hydroxide shall conform to ASTM F493 and be specially formulated for use with corrosive chemicals. Solvent shall be IPS Weld-On 724 or equal.
- E. Unions shall be Schedule 80, shall conform to the materials specifications for fittings, shall be socket joint, and shall utilize EPDM or Viton O-rings compatible with the chemical service.

## PART 3 EXECUTION

### 3.1 DELIVERY AND STORAGE OF PIPE

- A. Do not store pipe where exposed to direct sunlight or heat.
- B. Support the pipe uniformly.
- C. Do not install pipe that is gouged or scratched forming a clear depression.

### 3.2 SOLVENT CEMENTING

- A. Ensure that the pipe and fittings are at the same temperature prior to joining.
- B. Cut pipe ends square, remove all burrs, and slightly chamfer outside edge of pipe ends.
- C. Remove all dirt and moisture from the surfaces being joined.
- D. Measure the socket depth and mark distance on the pipe being inserted. Check the dry fit of the components prior to applying cement.
- E. Apply primer to both the pipe and fitting following the primer manufacturer's instructions.

- F. Apply solvent cement appropriate for the pipe material and service following the manufacturer's instructions.
- G. Allow the joint to set and cure following the cement manufacturer's instructions. Do not load the joint for at least 8 hours after joint assembly.

### 3.3 *INSTALLING UNIONS*

- A. Install unions at the following locations whether shown on the plans or not:
  - 1. Changes in direction
  - 2. Next to all valves and other equipment
  - 3. Every 10 feet on above grade straight pipe runs.
  - 4. Where shown on the drawings.

### 3.4 *INSTALLING BURIED PIPE*

- A. Follow standard ASTM D2774 installation practice.
- B. Snake the pipe in the trench per the pipe manufacturer's recommendations to account for thermal contraction and expansion.
- C. Support the pipe continuously on a smooth surface void of any stones or sharp objects.

### 3.5 *PAINTING AND COATING*

- A. PVC pipe is susceptible to degradation if left exposed to direct sunlight. Coat pipe exposed to direct sunlight per Section 09 90 00.

### 3.6 *FIELD HYDROSTATIC TESTING*

- A. Pressure test in accordance with Section 33 01 00.

### 3.7 *DISINFECTION*

- A. Disinfect pipe used in potable water applications in accordance with Section 33 13 00.

**END SECTION**

## **SECTION 40 24 68**

### **PVC SECONDARY CONTAINMENT PIPING**

#### **PART 1 GENERAL**

##### *1.1 WORK INCLUDED*

- A. This section includes materials, installation, and testing of PVC secondary containment piping.

##### *1.2 RELATED WORK*

- A. Section 40 05 00 – Piping and Fittings
- B. Section 33 13 00 – Disinfection of Water System
- C. Section 40 05 20 – Valves and Apputenances
- D. Section 40 20 10 – Pipe Supports
- E. Section 40 20 90 – PVC and CPVC Process and Chemical Piping

##### *1.3 REFERENCES*

- A. American Society for Testing and Materials (ASTM)
- B. American Water Works Association (AWWA)

##### *1.4 SUBMITTALS*

- A. Submittals shall be in accordance with the General Conditions and Section 01 33 00.
- B. Submit materials description for pipe, fittings, and other appurtenances with ASTM reference and grade and manufacturer's certification of compliance with referenced standards.
- C. Submit wall thickness and pressure rating of pipe and fittings.
- D. Submit manufacturer's installation instructions.

#### **PART 2 PRODUCTS**

##### *2.1 SECONDARY CONTAINMENT SYSTEM*

- A. Furnish a complete double-containment piping system including piping, fittings, anchors, terminations, access tees, carrier pipe supports and associated pipe joining method.).

- B. The system design shall meet the requirements of ASME/ANSI B31.3 for design criteria where temperature and pressure fall within the limits of that code.
- C. System shall provide the ability to incorporate leak detection. Access tees, pull ropes, and low-point instrumentation taps shall be provided as specified by the leak detection vendor and/or contract drawings. Supplier of Piping System shall specify Pipe Sizes to accommodate leak detection cable if utilized.

## 2.2 MANUFACTURER'S

- A. Secondary containment piping system shall be manufactured by Asahi/America, Spears Manufacturing, or equal.

## 2.3 DEFINITIONS

- A. Product Pipe: Inside Pipe/Carrier Pipe
- B. Containment Pipe: Outside Pipe

## 2.4 MATERIALS

- A. Product and containment pipe shall be PVC per the material, dimensional, and pressure rating requirements of Section 40 20 90.
- B. Any special fittings, not supplied as part of the normal product offering, shall be classified as unlisted components. Products falling into this category shall only be supplied by the manufacturer of the double containment System.

## 2.5 VALVES

- A. Valve arrangements that are to be double contained shall be supplied pre-assembled and tested to 150% of the maximum operating pressures. Actuators, stem extensions, and other accessories shall be part of a pre-assembled package.

## 2.6 PIPE SUPPORTS

- A. Centralizer supports, guides, etc. for product pipe shall be provided of same resin as product pipe. Supports shall be placed in a manner that a maximum of 0.1-inch deflection is allowed between supports. Supports shall allow axial movement of product pipe within containment pipe. Supports shall maintain a concentric relationship between product pipe and containment pipe. Supports shall be designed to allow the pulling of Leak Detection Cable through the pipe.
- B. Anchors shall be provided of same resin as product pipe and containment pipe. Anchors shall be of same wall thickness as product and containment pipe, and must be of unitary construction. Anchors shall be fully pressure rated.
- C. Support disks used to centralize fittings shall lock the product (carrier) fitting to the containment fitting. Free-floating fittings are not allowed. Support disks shall be designed to allow for flow and access cable in the annular space.

## 2.7 ACCESS TEES

- A. Access tees shall be provided per drawings and per leak detection manufacturer's requirements. Access tees shall be of same resin as pipe.

## PART 3 EXECUTION

### 3.1 DELIVERY AND STORAGE OF PIPE

- A. Do not store pipe where exposed to direct sunlight or heat.
- B. Support the pipe uniformly.
- C. Do not install pipe that is gouged or scratched forming a clear depression.

### 3.2 INSTALLATION

- A. Install piping system per manufacturer's recommended procedures.
- B. Install continuous running pull rope for installation of leak detection cable if required for leak detection system.

### 3.3 SOLVENT CEMENTING

- A. Ensure that the pipe and fittings are at the same temperature prior to joining.
- B. Cut pipe ends square, remove all burrs, and slightly chamfer outside edge of pipe ends.
- C. Remove all dirt and moisture from the surfaces being joined.
- D. Measure the socket depth and mark distance on the pipe being inserted. Check the dry fit of the components prior to applying cement.
- E. Apply primer to both the pipe and fitting following the primer manufacturer's instructions.
- F. Apply solvent cement appropriate for the pipe material and service following the manufacturer's instructions.
- G. Allow the joint to set and cure following the cement manufacturer's instructions. Do not load the joint for at least 8 hours after joint assembly.

### 3.4 INSTALLING BURIED PIPE

- A. Follow standard ASTM D2774 installation practice.
- B. Snake the pipe in the trench per the pipe manufacturer's recommendations to account for thermal contraction and expansion.

- C. Support the pipe continuously on a smooth surface void of any stones or sharp objects.

### 3.5 *FIELD HYDROSTATIC TESTING*

- A. Test product pipe hydrostatically per Section 33 01 00.
- B. Test containment pipe using one of the following two procedures:
  - 1. Test containment pipe hydrostatically per Section 40 05 15. The product pipe must be pressurized to the same pressure as the containment pipe to prevent collapsing of the product pipe.
  - 2. To avoid moisture in the containment space, an air test can be conducted on the containment pipe using air at 5 psi. The inner carrier pipe shall be full of water and under pressure to avoid any possible collapse. When testing with air, the ambient temperature should be above 40° F and extra safety precautions for personnel shall be put in place during the test.

### 3.6 *DISINFECTION*

- A. Disinfect pipe used in potable water applications in accordance with Section 33 13 00.

**END SECTION**

## SECTION 40 50 00

### INSTRUMENTATION AND CONTROLS – GENERAL PROVISIONS

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

- A. The Contractor shall procure the services of a single Process Control System Supplier (PCSS) and a single Pressure Filter System Supplier (PFSS) to furnish and install all materials, equipment, labor and services, except for those services and materials specifically noted, required to achieve a fully integrated and operational system as specified herein and in other Specification Sections listed below.
- B. Requirements specified in this Section apply to all equipment specified in the above sections, unless otherwise specified. The work shall include furnishing, installing and testing the equipment and materials detailed in the following Sections:
  - 1. 40 50 00 Instrumentation and Controls (I&C) - General Provisions
  - 2. 40 50 01 Testing
  - 3. 40 51 10 Computer System Hardware
  - 4. 40 51 20 PLC Hardware and Software
  - 5. 40 51 30 HMI System Software
  - 6. 40 51 50 Control Panels and Panel Mounted Equipment
  - 7. 40 51 70 SCADA Radio Communication Equipment
  - 8. 26 24 19 Motor Control Centers
- C. Auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, shall be included whether they are shown on the Drawings or not.
- D. Substitutions on functions or type of equipment specified shall not be acceptable unless specifically noted. In order to confirm compatibility between all equipment, coordinate all interface requirements with mechanical and electrical systems and furnish any signal isolation devices that might be required.
- E. Equipment shall be fabricated, assembled, installed and placed in operating condition in full conformity with the project Specifications, Drawings, engineering data, instructions, and recommendations of the equipment manufacturer as approved by the Engineer.
- F. To facilitate the Owner's future operation and maintenance, similar products (e.g., differential pressure transmitters, SCADA I/O cards) shall be supplied from the same manufacturer.
- G. All equipment and installations shall satisfy applicable Federal, State and local codes.

H. Use the equipment, instrument, and loop numbering scheme that has been developed and shown on the Drawings and specifications in the development of the submittals. Do not deviate from or modify said numbering scheme without the Engineer's approval.

I. The work of this project includes, but is not necessarily limited to the following:

#### 1.02 RELATED WORK

- A. Process Flow Diagrams (PFD) are included in the Drawings.
- B. Control System Architecture Block Diagram is included in the Drawings.
- C. Specific control system and instrumentation materials and requirements are included in related Sections of Division 40.
- D. Instrumentation and Controls conduit systems are specified in Section 26 05 33.

#### 1.03 SUBMITTALS

A. General submittal requirements include:

1. Refer to Division 01 for general submittal requirements.
2. Other Division 40 Sections may have additional submittal requirements.
3. Shop drawings shall be submitted as detailed herein. Shop drawings shall demonstrate that the equipment and services to be furnished comply with the provisions of these specifications and shall provide a complete record of the equipment as manufactured and delivered.
4. Submittals shall be complete; giving equipment specifications, details of connections, wiring, ranges, installation requirements, and specific dimensions. Submittals consisting of only general sales literature shall not be acceptable.
5. Submittals shall be bound in separate three-ring binders, with an index and sectional dividers, with all drawings reduced to a maximum size of 11-inch by 17-inch, then folded to 8.5 inch by 11 inch for inclusion within the binder. Maximum binder size shall be 3 inches.
6. The submittal drawings' title block shall include, as a minimum, the PCSS registered business name and address, Owner and project name, drawing name, revision level, and personnel responsible for the content of the drawing.
7. Incomplete or partial submittals not complying with the submittal arrangements outlined in this Section will be returned without review.
8. Separate submittals shall be made as follows:
  - a. Project Plan, Deviation List and Schedule Submittal
  - b. Application Development System Submittal
  - c. Coordination Meetings Agenda
  - d. I/O List Submittal
  - e. Field Instrument Submittal
  - f. Hardware Submittal and Software Packages Submittal
  - g. Panel Layout Drawings and Wiring Diagram Submittal



- h. Testing Plans Submittal
  - i. Training Plan Submittal
    - 1) Preliminary Training Plan Submittal
    - 2) Final Training Plan Submittal
  - j. Spares, Expendables, and Test Equipment Submittal
  - k. Final System Documentation
- B. Project Plan, Deviation List, and Schedule Submittal
1. Submit a Project Plan within 21 calendar days from Notice to Proceed date. The Project Plan shall, as a minimum, contain the following:
    - a. Overview of the proposed control system in clear text format describing the PCSS understanding of the project work, preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination.
    - b. Approach to work in clearly written format describing how the PCSS intends to execute the work. A discussion of switchover, startup, replacement of existing equipment with new, and other tasks as required by these specifications shall be included as applicable.
    - c. Preliminary HMI software, PLC software, and PLC hardware submittal information, including version numbers, solely to determine compliance with the requirements of the Contract Documents prior to development of system programming. Review and approval of software and hardware systems as part of this Project Plan stage shall not relieve the PCSS of meeting all the functional and performance requirements of the system as specified herein. Substitution of manufacturer or model of these systems after the submittal is approved is not allowed without Engineer approval.
    - d. Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include resumes of each key individual and specify in writing their commitment to this project.
    - e. Preliminary coordination meeting agendas as specified herein.
    - f. Preliminary testing plan
    - g. Preliminary training plan
    - h. Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum include samples of panel fabrication drawings, loop, I/O wiring diagrams, and graphical display presentations.
  2. Exceptions to the Specifications or Drawings shall be clearly defined in a separate Deviation List. The Deviation List shall consist of a paragraph by paragraph review of the Specifications indicating acceptance or any proposed deviations, the reason for exception, the exact nature of the exception and the proposed substitution so that an evaluation may be made by the Engineer. The acceptability of any device or methodology submitted as an "or equal" or "exception" to the specifications shall be at the sole discretion of the Engineer. If no exceptions are taken to the specifications or drawings the PCSS shall make a

statement as such. If there is no statement by the PCSS, then it is acknowledged that no exceptions are taken.

3. Project schedule shall be prepared and submitted using Primavera, Microsoft Project, or equal scheduling software. Schedule shall be prepared in Gantt chart format clearly showing task linkages for all tasks and identifying critical path elements. PCSS schedule must be based on the General Contractor schedule and must meet all field installation, testing, and start-up milestones in that schedule. The project schedule shall illustrate all major project milestones including the following:
    - a. All subsequent project submittals shall be scheduled. Include in the time allotment; the time required for Contractor submittal preparation, Engineer's review time, and a minimum of two complete review cycles.
    - b. Proposed dates for all project coordination meetings.
    - c. Hardware purchasing, fabrication, and assembly (following approval of related submittals)
    - d. Software purchasing and configuration (following approval of related submittals)
    - e. Shipment of all instrument and control system equipment
    - f. Installation of all instrument and control system equipment
    - g. Testing: Schedule for all testing. Testing schedule shall include submittal of test procedures a minimum of 30 days prior to commencement of testing. Schedule shall also include submittal of completed test procedure forms for review and approval by the Engineer prior to shipment, startup, or subsequent project work.
    - h. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each process controller and HMI server/workstation provided under this Contract.
    - i. Schedule for all training; including submittal and approval of O&M manuals, factory training, and site training.
- C. Coordination Meetings Agenda:
1. Agendas shall be submitted for the Coordination Meetings as specified herein. Submit proposed Control System Coordination Meeting Agenda a minimum of two weeks prior to the scheduled meeting date for review and comment by the Engineer.
- D. Input/Output (I/O) Address List Submittal
1. Submit a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.
  2. I/O list shall be based on the P&ID's, the Drawings, the design I/O list (if included within these specifications), and requirements outlined in the Specifications.
  3. The I/O list shall be submitted in both a Microsoft Excel readable electronic file format on a CD-ROM and an 8-1/2 inch by 11-inch hard copy.

4. The I/O list shall reflect all active and spare I/O points. Add points to accommodate spare I/O.
  5. The I/O list shall be arranged such that each control panel has a dedicated worksheet. At a minimum, I/O worksheet tables shall include the following information:
    - a. TAG NUMBER(S): The identifier assigned to a device that performs a function in the control system. As part of this information, the loop number of the tag shall be broken out to allow for sorting by loop.
    - b. DESCRIPTION: A description of the function of the device (text that includes signal source, control function, etc.) Include the text "Spare Points" for all I/O module points that are not connected to equipment.
    - c. PHYSICAL LOCATION: The Control Panel designation of where the I/O point is wired to.
    - d. PHYSICAL POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.
    - e. LOGICAL POINT ADDRESS: If the PCSS is performing the PLC programming, I/O address of each point. If the PCSS is not performing the PLC programming, then leave this field blank for use by the PFSS.
    - f. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO – Pulse Output.
    - g. RANGE/STATE: The range in engineering units corresponding to an analog 4-20 mA signal, or, the state at which the value of the discrete points are "1."
    - h. ENGINEERING UNITS: The engineering units associated with the Analog I/O.
    - i. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.
  6. The I/O list shall be sorted in order by:
    - a. Physical location
    - b. I/O Type
    - c. Loop Number
    - d. Device Tag
  7. After the I/O list is approved, do not modify the PLC I/O addresses without approval by the Engineer.
  8. Where multiple mechanical components are provided for process redundancy, their field connections to I/O modules shall be arranged such that the failure of a single I/O module will not disable all mechanical components of the redundant system. This applies to all I/O types.
- E. Field Instruments Submittal
1. Submit complete documentation of all field instruments using ISA-S20 data sheet formats. Submit a complete Bill of Materials (BOM) or Index that lists all

instrumentation equipment ordered by the loop numbering system as shown in the Contract Documents.

2. Submit separate data sheets for each instrument including:
    - a. Plant Equipment Number and ISA tag number per the drawings
    - b. Product (item) name used herein and on the Contract Drawings
    - c. Manufacturer's complete model number
    - d. Location of the device
    - e. Input / output characteristics
    - f. Range, size, and graduations in engineering units.
    - g. Physical size with dimensions, enclosure NEMA classification and mounting details in sufficient detail to determine compliance with the requirements of the Contract Documents.
    - h. Materials of construction for enclosure and wetted parts.
    - i. Instrument or control device sizing calculations where applicable.
    - j. Certified calibration data for all flow metering devices.
    - k. Two-wire or four-wire device type as applicable.
  3. Submit index and data sheets in electronic format as well as hard copies on 8-1/2 by 11 inches formats. Electronic format shall be in Microsoft Excel or Word. Submit electronic copy on CD-ROM or DVD disk.
- F. Hardware Submittal and Software Packages Submittal
1. For each hardware component indicated below, submit a cover page that lists, at a minimum, date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA S20, general data sheet; however, other formats will be acceptable provided they contain all required information.
  2. Catalog cuts for supplied Programmable Logic Controller (PLC), process controller equipment, remote telemetry units (RTU), including central processing units, redundancy units, memory, input modules, output modules, modems, network interface modules, mounting racks, and power supplies. Submit descriptive literature for each hardware component that fully describes the units being provided. Any deviation of the hardware systems from the preliminary hardware submittal included in the Process Plan or Applications Development System submittal shall be described in detail.
  3. Catalog cuts for HMI servers, HMI workstations, historian servers, memory, printers, mass storage devices, modems, peripherals, power supplies, networking and all other hardware being provided. Submit descriptive literature for each hardware component, which fully describes the units being provided.
  4. Complete system architecture diagram showing in schematic form, the interconnections between major hardware components including control centers, panels, power supplies, consoles, computer and peripheral devices, networking equipment, processors, I/O modules, local operator interfaces, and like equipment. The system architecture shall be complete and shall depict all

required cables, media type between components, network protocol used at each network level, details on connection requirements such as cable pin-outs, port numbers, and rack slot numbers. The intent of this specification requirement is for the PCSS to develop a diagram that is complete in every aspect to allow purchase of all required equipment by part number, and to allow a qualified technician to interconnect all equipment without having to refer to additional manuals or literature. Minimum sheet size shall be 11"x17" and using a larger sheet size or more than one sheet is acceptable.

5. Submit details of the controller development software package, the local operator graphic panel development software package, and the HMI software application packages to be used for each piece of equipment. Indicate all standard and optional features provided. Confirm in the submittal that the licenses will be assigned to the Owner at the time of purchase. Any deviation of the software platforms from the preliminary software submittal included in the Project Plan shall be described in detail.

#### G. Panel Layout Drawings and Wiring Diagrams Submittal

1. Where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions, the Contractor shall provide to the PCSS the approved shop drawings and submittals in order for the PCSS to provide complete wiring diagrams showing all wiring connections in the I/O system. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. These drawings will be included in the Final Documentation submittal. Leaving this information blank on the Final Documentation drawings is not acceptable.
2. Panel Layout Drawings: Drawings shall be furnished for all panels, consoles, and equipment enclosures specified. Panel assembly and elevation drawings shall be drawn to scale and detail all equipment in or on the panel. Panel drawings shall be 11"x17" minimum in size. As a minimum, the panel drawings shall include the following:
  - a. Interior and exterior panel elevation drawings to scale.
  - b. Nameplate schedule.
  - c. Conduit access locations.
  - d. Panel construction details.
  - e. Cabinet assembly and layout drawings to scale. The assembly drawing shall include a bill of material on the drawing with each panel component clearly defined. The bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify any component of the assembly by manufacturer and model number.
  - f. Fabrication and painting specifications including color (or color samples).
  - g. Submit construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.
  - h. Heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and

environmental conditions. Calculations shall include the recommended type of equipment required for both heating and cooling.

- i. Submit evidence that all control panels shall be constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. All costs associated with obtaining the UL seal and any inspections shall be borne by the Contractor and included in the Project Bid Price.
3. Panel Wiring Diagrams: Panel wiring diagrams depicting wiring within and on the panel as well as connections to external devices. If ISA Loop Wiring Diagrams are specified below, equipment external to the control panel and related external connections do not need to be shown on the Panel Wiring Diagrams. Panel wiring diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering. Field device wiring shall include the device ISA-tag and a unique numeric identifier. The diagrams shall identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the PCSS. Wiring labeling used on the drawings shall match that shown on the Contract Documents or as developed by the PCSS and approved by the Engineer. I/O wiring shall be numbered with rack number, slot number, and point number. Two-wire and four-wire equipment shall be clearly identified and power sources noted. Submit final wire numbering scheme. Panel drawings shall be 11" x17" minimum in size.
  4. ISA Loop Wiring Diagrams: Detailed ISA loop wiring diagrams showing requirements for each loop which is shown on the contract drawings. The Loop Drawings shall be prepared in accordance with ISA Standard S5.4 latest edition with the layout following Figures 5 and 6 (shown in the S5.4 Standard), titled "Minimum Required Items Plus Optional items". Loop drawings shall be 11"x17" minimum in size. The information required on the Loop Drawings in order to satisfy the "minimum" and "optional" requirements is as follows:
    - a. Minimum Required Items – The following information shall be provided on Loop Drawings in order to meet this requirement:
      - 1) Identification of the loop and loop components shown on the P&IDs. Other principal components of the loop to be shown and identified under ISA-5.1, "Instrumentation Symbols and Identification".
      - 2) Word description of loop functions within the title. If not adequate, use a supplemental note. Identify any special features or functions of shutdown and safety circuits.
      - 3) Indication of the interrelation to other instrumentation loops, including overrides, interlocks, cascaded set points, shutdowns and safety circuits.
      - 4) All point-to-point interconnections with identifying numbers or colors of electrical cables, conductors, pneumatic multitubes, and individual pneumatic and hydraulic tubing. This identification of interconnections includes junction boxes, terminals, bulkheads, ports, and grounding connections.

- 5) General location of devices such as field, panel, auxiliary equipment, rack, termination cabinet, cable spreading room, I/O cabinet, etc.
  - 6) Energy sources of devices, such as electrical power, air supply, and hydraulic fluid supply. Identify voltage, pressure, and other applicable requirements. For electrical sources, identify circuit or disconnect numbers.
  - 7) Process lines and equipment sufficient to describe the process side of the loop and provide clarity of control action. Include what is being measured and what is being controlled.
  - 8) Actions or fail-safe positions (electronic, pneumatic, or both) of control devices such as controllers, switches, control valves, solenoid valves, and transmitters (if reverse- acting). These are to be identified in accordance with ISA-5.1, "Instrumentation Symbols and Identification".
- b. Additional Required Items – The following information shall be provided on Loop Drawings (in a tabular format as shown in Figures 5 and 6 of ISA 5.4) in order to meet this requirement:
- 1) Process equipment, lines, and their identification numbers, source, designation, or flow direction.
  - 2) Reference to supplementary records and drawings, such as installation details, P&IDs, location drawings, wiring diagrams or drawings, and instrument specifications.
  - 3) Specific location of each device, such as elevation, area, panel subdivision, rack or cabinet number and location, I/O location.
  - 4) Cross reference between loops that share a common discrete component, such as multipen recorders, dual indicators, etc.
  - 5) References to equipment descriptions, manufacturers, model numbers, hardware types, specifications or data sheets, purchase order numbers.
  - 6) Signal ranges and calibration information, including setpoint values for switches, and alarm and shutdown devices.
  - 7) Software reference numbers, such as I/O addresses, control block types and names, network interfaces, point names.
  - 8) Engraving or legend information that helps identify the instrument or accessory. Per ISA-5.4-1991 11.
  - 9) Accessories, tagged or otherwise identified, such as regulators, filters, purge meters, manifold valves, root valves.
  - 10) References to manufacturer's documentation such as schematics, connection details, operating instructions.
  - 11) Color code identification for conductors or tubes that use numbers for differentiation.

#### H. Testing Plan Submittals

1. Test Procedure Submittals: Submit the procedures proposed to be followed for each test. Procedures shall include test descriptions, forms, and checklists to be

used to control and document the required tests. Include sign-off forms for each testing phase or loop with sign-off areas for the PCSS, Engineer, and Owner. Refer to Section 40 50 01 for specific testing requirements, and submit separate procedures for each specified test phase.

2. Test Documentation: Upon completion of each required test, document the test by submitting a copy of the signed off test procedures. Testing shall not be considered complete until the signed-off test procedures have been submitted and favorably reviewed. Submittal of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.
3. Each loop shall have a Loop Status signoff form to organize and track its inspection, adjustment and calibration. These forms shall include the following information and check-off items:
  - a. Project Name.
  - b. Loop Number.
  - c. Detailed test procedure indicating exactly how the loop will be tested including all required test equipment, necessary terminal block numbers, and simulation techniques required.
  - d. Tag Number for each component.
  - e. Check-offs/signoffs for each component.
    - 1) Tag/identification
    - 2) Installation
    - 3) Termination - wiring
    - 4) Termination - tubing
    - 5) Calibration/adjustment
  - f. Check-offs/signoffs for the loop.
    - 1) Panel interface terminations
    - 2) I/O interface terminations
    - 3) I/O signal operation
    - 4) Inputs/outputs operational: received/sent, processed, adjusted
    - 5) Total loop operation
    - 6) Space for comments.
    - 7) Sign off and date fields for the Contractor, the Engineer, and the PCSS.
4. Each active analog subsystem element shall have a Component Calibration form. These forms shall have the following information including space for data entry:
  - a. Project Name.
  - b. Loop Number.
  - c. ISA Tag Number and I/O Module Address.



- d. Manufacturer.
- e. Model Number/Serial Number.
- f. Summary of Functional Requirements. For example:
  - 1) For Indicators: Scale ranges
  - 2) For Transmitters/Converters: Scale and chart ranges
  - 3) For Computing Elements: Function
  - 4) For Controllers: Action (direct/reverse) control modes (PID)
  - 5) For Switching Elements: Unit range, differential (FIXED/ADJUSTABLE), reset (AUTO/MANUAL)
  - 6) For I/O Modules: Input or output
- g. Calibrations; for example:
  - 1) For Analog Devices: Required and actual inputs and outputs at 0, 50 and 100 percent of span.
  - 2) For Discrete Devices: Required and actual trip points and reset points.
  - 3) For Controllers: Mode settings (PID).
  - 4) For I/O Modules: Required and actual inputs or outputs for 0, 50 and 100 percent of span.
- h. Space for comments.
- i. Sign off and date fields for the Contractor, the Engineer, and the PCSS.
- I. Spares, Expendables, and Test Equipment Lists Submittal
  - 1. This submittal shall include for each Subsystem:
    - a. A list of, and descriptive literature for, spares, expendables, and test equipment as specified in Division 40.
    - b. A list of, and descriptive literature for, additional spares, expendables, and test equipment recommended by the manufacturer.
    - c. Unit and total costs for the additional spare items specified or recommended for each subsystem.
- J. Final System Documentation
  - 1. The Final System Documentation shall consist of operations and maintenance manuals as specified herein. The manuals shall be bound in three-ring binders, maximum size of three inches, with Drawings reduced to 11 inch by 17 inch, then folded to 8.5 inch by 11 inch for inclusion. Each section shall have a uniquely numbered tab divider, and each component within each section shall have a separate binder tab divider.
  - 2. The operations and maintenance manuals shall, at a minimum, contain the following information:
    - a. Table of Contents

- 1) A Table of Contents shall be provided for the entire manual with the specific contents of each volume clearly listed. The complete Table of Contents shall appear in each volume.
- b. Instrument and Equipment Lists
- 1) The following lists shall be developed in Excel and provided not only as a hardcopy in O&M but also electronically on a CD.
  - 2) An instrument list for all devices supplied including tag number, description, specification section and paragraph number, manufacturer, model number, serial number, range, span, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
  - 3) An equipment list for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, serial number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
- c. Data Sheets with Vendor Operations and Maintenance Information
- 1) ISA S20 data sheets shall be provided for all field instruments.
  - 2) Cover page for each device, piece of equipment, and OEM software that lists, at a minimum, date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA S20, general data sheet; however, other formats will be acceptable provided they contain all required information.
  - 3) Final vendor O&M documentation for each device, piece of equipment, or OEM software shall be either new documentation written specifically for this project, or modified standard vendor documentation. All standard vendor documentation furnished shall have all portions that apply clearly indicated with arrows or circles. All portions that do not apply shall be neatly lined out or crossed out. Groups of pages that do not apply at all to the specific model supplied shall be removed.
  - 4) For any component requiring dip switch settings or custom software configuration, that information shall be included along with the corresponding data sheets and O&M information.
- d. As-Built Drawings
- 1) Complete as-built drawings, including all drawings and diagram specified in this section under the "Submittals" section. These drawings shall include all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS.
  - 2) As built documentation shall include information from submittals, as described in this Specification, updated to reflect the as-built system. Any errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests shall be incorporated in this documentation.
- e. Original Licensed Software

- 1) Submit original software diskettes or CD-ROMs of all software provided under this Contract. Submit original paper based and electronic documentation for all software provided. Submit license agreement information including serial numbers, license agreements, User Registration Numbers and related information. All software provided under this Contract shall be licensed to the Owner at the time of purchase. Provide media in software sleeves within O&M manual.
- f. Electronic O&M Information
  - 1) In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals CDROM or DVD. Electronic documents shall be supplied in Adobe Acrobat format.
  - 2) Provide electronic files for all custom-developed manuals. Text shall be supplied in both Microsoft Office format and Adobe Acrobat format.
  - 3) Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format and in Adobe Acrobat format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, and fonts into individual zip files along with the drawing file.
  - 4) Each computer system hardware device shall be backed up onto CDROM or DVD after Substantial Completion and shall be turned over to the Owner.
  - 5) If specified in the training section, provide digital copies of all training videos. Videos shall be in a format that is readable by standard DVD players and by standard PC DVD drives. Format and shall be a minimum of 800 by 600 pixels and shall include sound.
3. The cover and edge of each volume shall contain the following information:
  - a. Project Name (refer to Contract Documents)
  - b. Contract Number (refer to Contract Documents)
  - c. Instrumentation and Control System Hardware[or Applications Engineering] Operations and Maintenance Manual
  - d. Specification Sections [List appropriate section]
  - e. Subcontractor Name
  - f. Date
  - g. Volume X of Y [Where X is the volume number and Y is the number of volumes]

#### 1.04 COORDINATION MEETINGS

- A. Schedule the mandatory coordination meetings as described herein. The meetings shall be held at the Owner's designated location and shall include attendance by the Owner, the Engineer, the Contractor, the PCSS's Project Engineer, and the PFSS's Project Engineer, if applicable. Other Division 40 specifications may require additional meetings.

1. A project kickoff coordination meeting shall be held within two weeks after submitting the Project Plan and Schedule Submittal. The purpose of the meeting shall be to discuss the PCSS's Project Plan and Schedule Submittal, to summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware and software related issues; and request any additional information required from the Owner. Prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date. The meeting will last up to one (1) business day.
2. A submittal review coordination meeting shall be held after the Hardware, Panel Drawing, and Loop Drawing Submittal package has been reviewed by the Engineer and returned to the PCSS and PFSS. The purpose of this meeting shall be to review comments made on the submittal package; to refine scheduled deadline dates; coordinate equipment installation activities; and provide a forum for any further required coordination between the PCSS and PFSS Supplier. The meeting will last up to one (1) business day.
3. Regular on-site meetings for during time PCSS staff is at the plant sites.

#### 1.05 REFERENCE STANDARDS

- A. Publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition in effect at the time of bid opening shall apply.
- B. International Society of Automation (formerly the Instrumentation, Systems and Automation Society) (ISA)
  1. ISA S5.2 Binary Logic Diagrams for Process Operations
  2. ISA S5.3 Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.
  3. ISA S5.4, Instrument Loop Diagrams
  4. ISA S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
  5. ISA RP60.3, Human Engineering for Control Centers
  6. ISA RP60.6, Nameplates, Labels, and Tags for Control Centers
- C. National Electrical Manufacturers Association (NEMA)
- D. National Fire Protection Agency (NFPA)
  1. NFPA 70, National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL)
  1. UL 508 – Industrial Control Equipment
- F. American Society for Testing and Materials (ASTM)
  1. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

#### 1.06 QUALITY ASSURANCE

- A. The Process Control System Supplier (PCSS) shall be a "systems integrator" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a "systems integrator" shall be interpreted to mean an organization that complies with all of the following criteria:
1. Employs personnel on this project who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. The Company shall be a member of Control System Integrators Association Certified (CSIA) and key personnel shall hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel shall include, as a minimum, the lead field technician.
  2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion shall be defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references shall be for projects where the PCSS's contract was of similar size to this project.
  3. Has been actively engaged in motor control centers, industrials control panels, and system integration for the type of work specified in this Specification Section for a minimum of five years.
- B. The PCSS shall maintain a permanent, fully staffed and equipped service facility within 250 miles of the project site with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSS shall be capable of responding to on-site problems within 12 hours of notice. Provide an on-site response within 4 hours of notification starting at two months before scheduled startup to two months after startup completion.
- C. PCSS shall hold a valid UL-508 certification for their panel fabrication facility.
- D. Actual installation of the instrumentation system need not be performed by the PCSS's employees; however, the PCSS as a minimum shall be responsible for the technical supervision of the installation by providing on site supervision to the installers of the various components.
- E. Only approved suppliers will be accepted. The Contractor must name the proposed system supplier per Division 00.
- F. The listed approved PCSS's shall not be required to submit a qualification proposal. Suppliers interested in being listed as an equal shall submit three copies of a qualification proposal to the ENGINEER no later than 21 days before the bid opening date. A list of approved equals shall be issued no later than 13 days before the bid opening date.
1. The qualification proposal shall provide details and a description of how the supplier proposes to fulfill the requirements set forth in these specifications. The PCSS shall present the proposal in sufficient detail so that proper evaluation regarding the experience and capabilities of the supplier can be performed.
    - a. The proposal shall contain evidence that the PCSS has sufficient financial resources to meet the obligations incidental to the performance of the work

including available bonding. (This requirement may be provided in the form of a verifiable or certified financial report for the company's latest fiscal year.)

- b. The proposal shall contain a list of personnel available for assignment to the responsible positions of Project Manager, Project Engineer, Installation Supervisor, and Area Service Representative. Also, include a concise resume of each individual's education, work experience, and accomplishments.
- c. The proposal shall contain the following specific information:
  - 1) Maintenance services available for hardware and software: Evaluation shall be based on the PCSS's capability to provide the required routine and emergency services. The PCSS's proposal is to describe the capabilities and location of his/her nearest (to jobsite) service organization. The intent of the specifications is to obtain all system maintenance services from the PCSS. If the PCSS intends to subcontract all or portions of the service requirements, it must be stated as such along with the name and address of the organization.
  - 2) Technical validation, examples of recently completed and similar scope projects: The PCSS shall provide information regarding type, size, complexity, and performance of five systems recently completed, along with names, addresses, and telephone numbers of persons qualified to verify PCSS's statements approximate cost of the instrumentation system supplied, project completion date and description. Evaluation shall be based on the similarity of system requirements and supplier's performance.
  - 3) A description of how the supplier plans to execute the various functions and locations where the various portions of the work shall be performed, coordinated and managed (e.g., design, engineering, manufacturing, programming, testing and scheduling). The PCSS is required to state in his/her proposal those functions which he/she intends to subcontract to other organizations and include the name, address and capabilities of these organizations.
  - 4) The PCSS shall be required to demonstrate a minimum of five years' past control systems of comparable size, type and complexity to the proposed project. The PCSS shall be required to have his/her own in-house capability to handle complete system engineering, fabrication, and testing.
  - 5) The PCSS shall indicate that he/she has in his/her employment capable personnel for detailed engineering, coordination, drafting, procurement and expediting, scheduling, construction, testing, inspection, installation, training start up service for calibration and commissioning and warranty compliance for the period specified.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, storage, and handling shall be in accordance with Division 01.
- B. Shipping Precautions
  1. After completion of shop assembly, factory test and approval of all equipment, cabinets, panels and consoles shall be packed in protective crates and enclosed

in heavy duty (5 mil) polyethylene envelopes or secured sheeting to provide protection from damage, dust and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling at the job site.

2. Manufacturer's special instructions for field handling, storage and installation required for protection, shall be securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in resealable plastic bags or other means of protection.
3. None of the HMI control and monitoring equipment shall be shipped to the site until the control room areas comply with specified ambient temperature and humidity. Have qualified personnel accept the equipment on delivery and supervise unloading within the control room areas.
4. If any apparatus has been damaged, such damage shall be repaired at no additional cost to the owner.

#### **1.08 NOMENCLATURE AND IDENTIFICATION**

##### **A. Field Instrument Tags**

1. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as indicated in the Drawings, shall be provided on each piece of equipment supplied under this Section. Equipment shall be tagged before shipping to the site.
2. Provide 1/8-in by 3/8-in, Type 316 stainless steel button head machine screws.
3. All supplied field instrument transmitters and field instrument transmitter elements shall have a stainless steel identification tag attached to each transmitter and element prior to shipment. Tag shall be attached via stainless steel chain or stainless steel wire (24 gauge inches. Tag shall include the ISA alphanumeric instrument number as indicated in the P&ID, loop, and detail drawings. The alphanumeric instrument number shall be stamped into the tag and shall have a minimum of 3/16-in high alphanumeric characters.

##### **B. Panel Nameplates**

1. See Section 40 51 50.

#### **1.09 WARRANTY**

- A. Provide warranty per Section 00 65 36, Warranties and Bonds, and as specified herein.

#### **1.10 PROJECT/SITE REQUIREMENTS**

- A. Environmental Requirements. Refer to Section 26 05 00 and the Electrical Drawings for specific environmental and hazardous area classifications.
- B. Elevation: Equipment shall be designed to operate at the project ground elevation.
- C. Temperature:
  1. Outdoor areas' equipment shall operate [between - 30 to 50 C degrees ambient].

2. Equipment located in indoor locations shall operate between [10 to 35 C] degrees ambient minimum.
  3. Storage temperatures shall range from [0 to 50 C] degrees ambient minimum.
  4. Additional cooling or heating shall be furnished if required by the equipment as specified herein.
- D. Relative Humidity: Air conditioned area equipment shall operate between 20 to 95 percent relative, non-condensing humidity. All other equipment shall operate between 0 to 100 percent relative, condensing humidity.

## **PART 2 - PRODUCTS**

### **2.01 PRODUCTS GENERAL**

- A. All instrumentation and electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and epoxy or equal coating to prevent contamination by dust, moisture and fungus. The field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.
- B. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks unless otherwise noted. Fasteners for securing control panels and enclosures to walls and floors shall be either hot-dipped galvanized after fabrication or stainless steel. Provide stainless steel fasteners only in corrosive areas rated NEMA 4X on the Drawings or as defined under Division 26. Provide and size anchors in accordance with Divisions 01 and 05 as required per the seismic calculations. Provide minimum size anchor of 3/8-inch.
- C. All indicators shall be linear in process units, unless otherwise noted. All transmitters shall be provided with indicators in process units, accurate to two percent or better.
- D. All equipment, cabinets and devices furnished shall be heavy-duty type, designed for continuous industrial service. The system shall contain similar products of a single manufacturer, and shall consist of equipment models, which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.
- E. All electronic/digital equipment shall be provided with radio frequency interference protection.
- F. Electrical
  1. Equipment shall operate on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
  2. With the exception for field device network connected devices, all electronic instrumentation shall utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless



specified otherwise. However, signals between instruments within the same panel or cabinet may be 1-5 VDC (volts direct current).

3. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero based signals will be allowed.
4. All switches shall have double-pole double-throw contacts rated at a minimum of 600 VA, unless noted otherwise.
5. Switches and/or signals indicating an alarm, failure or upset condition shall be wired fail- safe to the SCADA system. A fail-safe condition is an open circuit when in an alarm state.
6. Materials and equipment shall be UL approved. Where components are not available with UL approval, integrate the device with ground fault protective devices, isolation transformers, fuses, or other protective equipment necessary to achieve compliance with UL 508 requirements.
7. All equipment furnished shall be designed and constructed so that in the event of power interruption, the systems specified herein shall go through an orderly shutdown with no loss of memory, and shall resume normal operation without manual resetting when power is restored, unless otherwise noted.
8. All transmitter output signals shall include signal and power source isolation.

## 2.02 ELECTRICAL SURGE PROTECTION

- A. General - Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the plant electrical system. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self-restoring. Devices shall have a response time of less than 50 nanoseconds and be capable of handling a discharge surge current (at an  $8 \times 20 \mu\text{s}$  impulse waveform) of at least 8 kA. Ground wires for all instrumentation device surge protectors shall be connected to a low resistance ground in accordance with Section 26 05 00.
- B. Provide protection of all analog signal (4-20 mA) circuits where any part of the circuit is outside of the building envelope. Circuits shall be protected at both the transmitter and the control system end of the circuit. Protection devices located near the transmitter shall be mounted in a separate enclosure, unless conduit mounted, and shall be Phoenix Contact PT Series, MTL Surge Technologies (Telematic) TP48, Citel TSP-10 series, or equal. Substitution of a single device to protect both 120 VAC and 4-20 mA wires to an instrument is acceptable. Protection devices in control panels shall be MTL Surge Technologies (Telematic) SD Series, Phoenix Contact PT Series, Citel BP1-24, or equal.
- C. Provide protection of all 120 VAC power feeds into control panels, instruments, and control room equipment. Surge arresters shall be Transtector ACP-100BW Series, Phoenix Contact "Mains-PlugTrab", MCG Surge Protection 400 Series, or equal.
- D. Non-Fiber Based Data Highway or Communications Circuits – Provide protection on all communication and data highway circuits that leave a building or are routed external to a building. Circuit protection shall be provided at both ends of the line.

Surge protection devices shall be Phoenix Contact PlugTrab Series, Transtector FSP Series, MTL Surge Technologies (Telematic) NP Series, or equal.

- E. Inductive Loads – At a minimum, provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120 VA or less that drive solenoid, coil, or motor loads.
- F. Telephone Circuits - At a minimum, provide Telephone Company approved line protection units for all telephone lines used for telemetry or SCADA system use under this Contract.

### 2.03 TUBING AND FITTINGS

- A. All instrument air header takeoffs and branch connections less than 2-in shall be 316 stainless steel.
- B. All instrument shut-off valves and associated fittings shall be supplied in accordance with the piping specifications and all instrument installation details. The materials for fittings and valves shall be compatible with process fluids. Where metallic fittings and valves are compatible, wetted materials shall be Type 316 stainless steel.
- C. The materials for instrument tubing shall be compatible with process fluids. Where metallic tubing is compatible, tubing shall be fully annealed ASTM A269 Seamless 316 grade free of OD scratches having the following dimensional characteristics as required to fit the specific installation:
  - 1. 1/4-in to 1/2-in O.D. by 0.035 wall thickness
  - 2. 5/8-in to 1-in O.D. by 0.049 wall thickness
  - 3. 1-in O.D. by 0.065 wall thickness
  - 4. 1-1/4-in O.D. by 0.065 wall thickness
  - 5. 1-1/2-in O.D. by 0.083 wall thickness
  - 6. 2-in O.D. by 0.095 wall thickness
- D. All process connections to instruments shall be annealed 1/2-inches O.D. stainless steel tubing, Type 316.
- E. All tube tracks shall be supported by stainless steel and installed as per manufacturer's installation instructions.

### 2.04 SPARE PARTS

- A. Spare parts of the type and quantity as recommended by the manufacturer shall be furnished for all devices furnished under these sections.
- B. All spare parts shall be wrapped in bubble wrap, sealed in a polyethylene bag complete with dehumidifier, then packed in cartons and labeled with indelible markings. Complete ordering information including manufacturer's part number, part ordering information including manufacturer, part number, part name, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by the Engineer.
- C. As a minimum, furnish the following spare parts for control panels:

1. Timers - Five of each type installed
  2. Relays - Five of each type installed
  3. Fuses and circuit breakers - 10% (minimum of 10 fuses and 2 circuit breakers) of each type and size installed
  4. Light bulbs - 10% (minimum of 10) of each type installed
  5. Power supplies - one of each type installed.
  6. Manufacturer's cables - one of each type installed.
  7. Selector switches/pushbuttons - Two of each type installed including 5 contact blocks.
  8. Surge protection devices - One of each type installed.
  9. Provide one quart of touch-up paint, for each type and color used for all RTU cabinets, panels, and consoles supplied.
- D. The following field Instrument related Spare Parts shall be furnished:
1. Miscellaneous: One year supply of items recommended by the manufacturer of the equipment including all reagents, dissolved oxygen probes, batteries, and calibration standards as needed to operate and maintain the furnished equipment.
- E. PLC components
1. One spare CPU of each type supplied for each plant
  2. Two spare I/O modules of each type supplied for each plant
  3. One spare specialty interface module of each type supplied for each plant
  4. One spare power supply of each type supplied for each plant

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION**

- A. Instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms and similar devices indicated are approximate only. Exact locations of all devices shall be as approved by the Engineer during construction. Obtain in the field, all information relevant to the placing of process control equipment and in case of any interference with other work, proceed as directed by the Contractor and furnish all labor and materials necessary to complete the work in an approved manner at no additional cost to the Owner.
- B. All equipment used in areas designated as hazardous shall be designed for the Class, Group and Division as required for the locations as shown on the Drawings and specified in Division 26. All work shall be in strict accordance with codes and local rulings.
- C. Unless specifically indicated, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, 5-valve manifolds for

calibration, testing and blow down service shall also be provided. For chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

- D. All piping and tubing to and from field instrumentation shall be provided with necessary unions, calibrations and test tees, couplings, adaptors, and shut-off valves. Process tubing shall be installed to slope from the instrument toward process for gas measurement service and from the process toward the instrument for liquid measurement service. Provide drain/vent valves or fittings at any process tubing points where the required slopes cannot be maintained. Process tubing shall be installed rigidly with supports to prevent significant vibrations.
- E. Brackets and hangers required for mounting of equipment shall be provided. They shall be installed as shown and not interfere with any other equipment.
- F. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded at only one ground point for each shield.
- G. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, ship material in sections sized to permit passing through restricted areas in the building. Provide on-site service to oversee the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval. Certify that field wiring associated with his/her equipment is installed in accordance with best industry practice. Schedule and coordinate work under this section with that of the electrical work specified under applicable Sections of Division 26.
- H. Installation of fiber optic cable within control panel and console assemblies. Refer to cable manufacturer's specifications for bend radius. Use cable breakout assembly as recommended by the cable manufacturer. Provide wire basket, strain relief as required to meet manufacturer's strain requirements.
- I. Provide local electrical shutoffs and disconnects for all 4-wire field instruments requiring 120 VAC power. Electrical disconnects shall be suitably rated disconnect switches or manual motor starters as specified under Division 26.
- J. Provide sunshades for equipment mounted outdoors in direct sunlight. Sunshades shall include standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North or as required to minimize the impact of glare on LED, LCD, or other digital readouts.
- K. Loop Tuning - All electronic control stations incorporating PID controllers shall be tuned following field installation and calibration of instrumentation and control system components, but prior to commencement of the specified field tests. Field testing will be immediately 'failed' if loop tuning for the entire installed system is not complete.
  - 1. Optimal loop tuning shall be achieved either by auto-tuning software or manually by trial and error, Ziegler-Nichols step-response method, or other documented process tuning method. Assigning common PID factors for identical loops following field tuning of a single typical loop is acceptable. However, tuning documentation shall be submitted for each loop individually as specified in Part 1 of these Specifications.
  - 2. Determine and configure optimal tuning parameters to assure stable, steady state operation of final control elements running under the control of field mounted, dedicated PID controllers or software based PID controllers residing as part of the programmable logic controller system. Each control loop that includes

anti-reset windup features shall be adjusted to provide optimum response following startup from an integral action saturation condition.

3. Tune all PID control loops to eliminate excessive oscillating final control elements. Loop parameters shall be adjusted to achieve 1/4 amplitude damping or better. In addition, loop steady state shall be achieved at least as fast as the loop response time associated with critical damping.
4. Loop performance and stability shall be verified in the field following tuning by step changes to setpoint. Submit loop tuning methodology and verification as part of the final system documentation as specified in Part 1.
5. For cascade loops, tune both sets of controllers so that the cascade loop achieves the loop tuning characteristics specified herein.

### 3.02 TESTING

- A. Refer to Section 40 50 01.

**END OF SECTION**

## **SECTION 40 50 01**

### **I&C – TESTING**

#### **PART 1 - GENERAL**

##### **1.01 SCOPE OF WORK**

- A. Furnish all labor and materials required and installed. Complete as shown on the Drawings and as specified herein.
- B. This section covers the testing requirements for all devices and systems furnished and installed detailed on the Drawings and in the Loop Diagrams, and as described in the related Sections of Division 40.
- C. Refer to Section 40 50 00.

##### **1.02 RELATED WORK**

- A. Refer to Section 40 50 00.

##### **1.03 SUBMITTALS**

- A. Refer to Section 40 50 00.

##### **1.04 REFERENCE STANDARDS**

- A. Refer to Section 40 50 00.

##### **1.05 QUALITY ASSURANCE**

- A. Refer to Section 40 50 00.

##### **1.06 SYSTEM DESCRIPTION**

- A. N/A

##### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Refer to Section 40 50 00.

##### **1.08 PROJECT/SITE REQUIREMENTS**

- A. Refer to Section 40 50 00.

##### **1.09 MAINTENANCE**

- A. Refer to Section 40 50 00.

##### **1.10 WARRANTY**

- A. Refer to Section 40 50 00.

##### **1.11 NOMENCLATURE AND IDENTIFICATION**

- A. Refer to Section 40 50 00.

##### **1.12 COORDINATION MEETINGS**

- A. Refer to Section 40 50 00.

## **PART 2 - PRODUCTS**

### *2.01 NOT USED*

## **PART 3 - EXECUTION**

### *3.01 TESTING - GENERAL*

- A. See execution requirements in Section 40 50 00.
- B. As part of the requirement of this specification section, it is the responsibility of the PCSS to provide a complete operational control system for Well 1 and Well 3. Confirmation of an operational control system is dependent upon results derived from test procedures as specified in this Section. The PCSS shall test all equipment at the factory prior to shipment. Unless otherwise specified in the individual specification sections, all equipment provided by the PCSS shall be tested at the factory as a single fully integrated system.
- C. The PCSS shall test the system so that the Owner and Engineer can verify all the points in the existing control system. The PCSS shall coordinate testing of the ORT and FDT with the Owner.
- D. At a minimum, the testing shall include the following:
  - 1. Unwitnessed Factory Test (UFT).
  - 2. System Integration Test (SIT).
  - 3. Operational Readiness Test (ORT).
  - 4. Functional Demonstration Test (FDT).
  - 5. 30-day Site Acceptance Test (SAT).
- E. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and, upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.
- F. All tests shall be conducted in accordance with prior Engineer and/or Owner-approved procedures, forms, and all checklists as submitted by the PCSS under Specification 40 50 00 Part 1.03. Each test to be performed shall be described and a space provided after it for sign-off by the appropriate parties after its satisfactory completion. The PCSS shall include "punchlist" forms with the test procedures to document issues that arise during the testing. Punchlist forms, at a minimum, shall include a specification cross reference; an issues description field; a resolution description field; and a sign-off area for the PCSS, Owner, and Engineer.
- G. Copies of the signed-off test procedures, forms, and checklists will constitute the required testing documentation. The test result forms shall be submitted to the Engineer for approval within 10 days of completion of each test.
- H. The PCSS shall provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide

suitable means of simulation. These simulation techniques shall be defined in the test procedures.

- I. The PCSS shall coordinate all required testing with the Contractor, all affected Subcontractors, the Engineer, and the Owner.
- J. The PCSS shall furnish the services of field service engineers, all special calibration and test equipment, and labor to perform the field tests.
- K. The Engineer reserves the right to test or retest all specified functions, whether or not explicitly stated on the Test Procedures, as required to determine compliance with the functional requirements of the overall system. Such testing required to determine compliance with the specified requirements shall be performed at no additional cost to the Owner. The Engineer's decision shall be final regarding the acceptability and completeness of all testing.
- L. No equipment shall be shipped until the Engineer and/or Owner has received all test results and approved the system is ready for shipment.
- M. Correction of Deficiencies
  1. All deficiencies in workmanship and/or items not meeting specified testing requirements shall be corrected to meet specification requirements at no additional cost to the Owner.
  2. Testing, as specified herein, shall be repeated after correction of deficiencies is made until the specified requirements are met. This work shall be performed at no additional cost to the Owner.

### 3.02 *FACTORY TESTING - UNWITNESSED FACTORY TEST (UFT)*

- A. Prior to shipment of the equipment, the entire system, except primary elements, final control elements, and field-mounted transmitters, shall be interconnected and tested to ensure the system will operate as specified. All analog and discrete input/output points not interconnected at this time shall be simulated to ensure proper operation of all alarms, monitoring devices/functions, and control devices/functions.
- B. All panels, consoles, and assemblies shall be inspected and tested to verify their conformance with related submittals, Specifications, and Drawings.
- C. During the tests, all digital system hardware and software shall be operated for at least five days continuously without a failure to verify the system is capable of continuous operation.
- D. Tests to be performed shall include, but not be limited to, the following. Each of these tests shall be specifically addressed in the Test Procedure submittal.
  1. All panels and enclosures being provided shall undergo a thorough inspection to verify the integrity of the cabinet enclosures, frame structures, paint work and finish, etc. Additionally, the PCSS shall review the panel drawings with the Owner and/or Engineer to ensure they accurately reflect the panel layout and wiring.
  2. Panel wire pull tests shall be performed on all wiring to ensure all wiring has been connected to the appropriate torque to prevent wires from coming loose.
  3. For panels provided in new enclosures, heat loading tests shall be performed to ensure proper cooling/ventilation is being provided.



4. UPSs shall be tested with all equipment connected to verify the UPSs have been sized correctly to maintain the specified run time.
5. An I/O point checkout of at least 50 percent of each I/O module shall be performed to verify proper operation of the input/output points. To perform this test, the PCSS shall obtain copies of the PLC configuration files from the Application Engineering Services (AES) Supplier prior to proceeding with the UFT. The verification of the signals will be accomplished via the use of the PLC programming software. At a minimum, the I/O checkout shall consist of four steps.
  - a. Digital input signals shall be jumpered within the termination connections of the PLC panels and verification of proper alarming, statuses, etc., shall be performed utilizing the tools available in the PLC programming software.
  - b. Analog input signals shall be connected to a signal generator at the termination connections and signals shall be verified at zero percent, 25 percent, 50 percent, 75 percent, and 100 percent of full scale. The appropriate scaled value shall be verified utilizing the tools available in the PLC programming software.
  - c. Digital output signals shall be initiated by the user by writing to the signals utilizing the PLC programming software. Verification shall occur in the PLC panel by connecting a digital multimeter to measure the continuity at the terminations, thus verifying the command from the PLC has properly executed the contact closure.
  - d. Analog output signals shall be initiated by the user by writing to the signals utilizing the PLC programming software. Verification shall occur in the PLC panel by utilizing a digital multimeter to measure the current/voltage generated at the termination points.
- E. All control panels provided or modified under the requirements of the related technical specification sections of Division 40 shall be included in these tests.
- F. Upon successful completion of the UFT, the PCSS shall submit a record copy of the test results to the Owner and Engineer and coordinate the scheduling of the SIT with the AES Supplier.

### 3.03 *FACTORY TESTING - SYSTEM INTEGRATION TEST (SIT)*

- A. Before scheduling the SIT, the PCSS shall determine through his own UFT and through his internal quality assurance program that the equipment is ready for the SIT.
- B. The SIT shall be conducted a minimum of three weeks before the Witnessed Factory Test. The SIT shall be a joint test by the PCSS and the AES Supplier conducted at the PCSS's facility. As part of the requirements of Section 40 50 00-1.06, the PCSS's factory testing facility shall be within 200 miles of project site. The test will be an unwitnessed test, and the PCSS shall include time within the construction schedule for this test.
- C. The purpose of the SIT is to allow the PCSS and the AES Supplier to jointly verify the functionality, performance, and stability of the hardware and software as a complete integrated system. The AES Supplier will load the application software on the PLCs, SCADA servers, and historian. The entire system will then be tested. All

process control strategies shall be simulated to ensure proper operation. The primary objective of the SIT is to allow the PCSS and the AES Supplier to perform a dry run of the WFT and thus verify the system's readiness to move forward with the WFT.

- D. The PCSS and AES Supplier shall utilize the approved WFT Procedures as the basis for the tests to be performed during the SIT.
- E. Minimum testing to be performed during the SIT shall include, but not be limited to, the following:
  - 1. Verification of proper scanning, communication, and complete data acquisition of the entire system.
  - 2. Verification of all redundant functionality of components.
  - 3. Verification of proper power failure recovery.
  - 4. Verification of proper indication for communication error issues.
  - 5. A complete I/O point checkout shall be performed to verify proper operation of each input/output point. The I/O checkout shall consist of four steps.
    - a. Digital input signals shall be jumpered within the termination connections of the PLC panels and verification of proper alarming, statuses, etc., shall be performed at the HMI.
    - b. Analog input signals shall be connected to a signal generator at the termination connections and signals shall be verified at zero percent, 25 percent, 50 percent, 75 percent, and 100 percent of full scale. The appropriate scaled value shall be verified at the HMI. Simultaneously, verification of alarming shall occur. The alarming verification shall, at a minimum, include HiHi, Hi, Lo, LoLo, Rate of Change, and Alarm Deadband.
    - c. Digital output signals shall be initiated by the user from the HMI system. Verification shall occur within the PLC panel by connecting a digital multimeter to measure the continuity at the terminations, thus verifying the command from the PLC has properly executed the contact closure.
    - d. Analog output signals shall be initiated by the user from the HMI system. Verification shall occur in the PLC panel by utilizing a digital multimeter to measure the current/voltage generated at the termination points.
  - 6. Upon successful completion of the SIT, the PCSS shall submit a record copy of the test results to the Owner and Engineer and request the scheduling of the WFT as noted below.

### **3.04 FIELD TESTING - OPERATIONAL READINESS TEST (ORT)**

- A. Following installation of the process control system components and prior to startup and the Functional Demonstration Test, the entire system shall be certified (inspected, wired, calibrated, tested, etc., and documented) that it is installed and ready for the ORT as defined below.
- B. Loop/Component Inspections and Tests: The entire system shall be checked for proper installation, calibrated, and adjusted on a loop-by-loop and component-by-component basis to ensure that it is in conformance with related submittals and these Specifications.

- C. The Loop/Component Inspections and Tests shall be implemented using Engineer-approved forms and checklists. Each loop shall have a Loop Status Report to organize and track its inspection, adjustment, and calibration. These reports shall include the following information and check-off items with spaces for sign-off by the system supplier:
1. Project Name, Test Date, PCSS Name, and Lead PCSS Technician Name.
  2. Loop Number.
  3. Tag Number for each component.
  4. Check-offs/sign-offs for each component: Tag/identification; installation; termination (wiring and tubing); scale, range, and setpoint as applicable; and calibration/adjustment (four-point for analog, set point for switches) rising and falling.
  5. Check-offs/sign-offs for the loop: Panel interface terminations; I/O interface terminations; I/O signal operation; inputs/outputs operational (received/sent, processed, adjusted); total loop operation; process controller scaling and adjustment; and space for comments.
  6. Each active Analog Subsystem element and each I/O module shall have a Component Calibration Sheet. These sheets shall have the following information, spaces for data entry, and a space for sign-off by the PCSS.
    - a. Project Name.
    - b. Loop Number.
    - c. Component Tag Number of I/O Module Number.
    - d. Component Code Number Analog System.
    - e. Manufacturer (for Analog system element).
    - f. Model Number/Serial Number (for Analog system).
    - g. Summary of functional requirements shall include, but not be limited to, scale and chart ranges of indicators, recorders, and transmitters/converters; functions of computing elements; and parameters of controllers (i.e., proportional, integral, derivative, reverse/forward acting, etc.).
    - h. Calibrations shall include testing of analog input and output signals at zero, 10, 50, and 100 percent of span. Where appropriate, discrete input signals shall include details regarding actual trip points and reset points.
    - i. Space for comments.
    - j. Space for sign-off by the PCSS.
- D. The PCSS shall maintain the Loop Status Reports sheets at the job site and make them available to the Engineer/Owner at any time.
- E. These inspections, calibrations, and tests do not require witnessing. However, the Engineer will review Loop Status Sheets and spot-check the PCSS test process periodically. Any deficiencies found shall be corrected by the PCSS prior to commencement of the Functional Acceptance Test.

- F. Prior to checkout of the I/O to the HMI, the PCSS shall thoroughly test all I/O from the field device to the PLC terminals, and verify the PLC is powered up and the PLC is communicating to the SCADA servers. After the PCSS has successfully tested all I/O from the field devices to the PLC terminals, the PCSS and AES Supplier shall jointly test all I/O from the HMI to the field device. Should this test prove to be unsuccessful, the PCSS and AES Supplier shall test from the HMI to the terminations located in the Owner's termination cabinet, and the PCSS shall inform the Owner in writing of the discrepancy with the existing field wire.
- G. Computer-Manual (i.e., Remote-Manual) start/stop, open/close commands of all devices controlled by the SCADA system shall be verified jointly by the PCSS and AES Supplier during the ORT. Subsequent to verification of Computer-Manual control, the PCSS may request from the Owner and Engineer permission to begin replacement of the next PLC. Simultaneously, the AES Supplier may continue with Computer-Automatic testing to confirm the control strategies were implemented as specified.
- H. For all panels with enclosures (new and existing) modified by this contract, heat load tests shall be performed to ensure proper cooling/ventilation is being provided.
- I. Upon successful completion of the ORT, the PCSS shall submit a record copy of the test results to the Owner and Engineer and request the scheduling of the FDT as noted in the following section.

### 3.05 *FIELD TESTING - FUNCTIONAL DEMONSTRATION TEST (FDT)*

- A. Prior to startup and the 30-day Site Acceptance Test, the entire installed instrument and control system shall be certified that it is ready for operation. All preliminary testing, inspection, and calibration shall be complete as defined in the ORT. The FDT will be a joint test by the PCSS and the AES Supplier.
- B. Once a process area has been started up and is operating, a witnessed FDT shall be performed on that system to demonstrate that it is operating and is in compliance with these Specifications. A witnessed FDT shall be performed on each process area. Each specified function shall be demonstrated on a paragraph-by-paragraph, loop-by-loop, and site-by-site basis.
- C. Loop-specific and non-loop-specific tests shall be the same as specified under WFT, except that the entire installed system shall be tested and all functions demonstrated using live field-based data to the greatest extent possible.
- D. Updated versions of the documentation specified to be provided for during the factory tests shall be made available to the Engineer at the job site both before and during the tests. In addition, one copy of all O & M Manuals shall be available for reference at the job site, both before and during testing.
- E. The daily schedule specified to be followed during the factory tests shall also be followed during the FDT.
- F. During the FDT, a demonstration of communication failure and recovery shall be accomplished. This test shall be scheduled and coordinated with Owner's personnel to minimize the impact on plant operations.
- G. Following initial startup, the entire process control system shall operate for a continuous 100 hours without failure before this test will be started.

- H. Punchlist items and resolutions noted during the test shall be documented on the Punchlist/Resolution form. In the event of rejection of any part or function test procedure, the PCSS shall perform repairs, replacement, and/or retest within 10 days.
- I. Upon successful completion of the FDT, the PCSS shall submit a record copy of the test results to the Owner and Engineer and request the scheduling of the SAT as noted in the following section.

**3.06 FIELD TESTING - 30-DAY SITE ACCEPTANCE TEST (SAT)**

- A. After completion of the Operational Readiness and Functional Demonstration Tests, the system shall undergo a 30-day Site Acceptance Test (SAT), under conditions of full plant process operation, without a single non-field-repairable malfunction. The SAT will be a joint test by the PCSS and the AES Supplier.
- B. During this test plant operations, PCSS personnel and AES Supplier personnel shall be present as required to address any potential issues that would impact the overall system operation. The PCSS is expected to provide personnel for this test who have an intimate knowledge of the hardware, software, field wiring and network configuration of the system. The AES Supplier is expected to provide personnel for this test who have an intimate knowledge of the software programming of the system. When PCSS personnel are not on-site, the PCSS shall provide cell phone/pager numbers that Owner personnel can use to ensure that support staff are available by phone and/or on-site within four hours of a request by operations staff.
- C. While this test is proceeding, the Engineer and Owner's Agent shall have full use of the system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes. Plant operations shall remain the responsibility of Owner and the decision of plant operators regarding plant operations shall be final.
- D. Any malfunction during the tests shall be analyzed and corrections made by the AES Supplier for software programming issues, and the PCSS for hardware, software, field wiring and network configuration issues. The Engineer and/or Owner will determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.
- E. Any malfunction during this 30 consecutive day test period which cannot be corrected by the PCSS's personnel within 24 hours of occurrence, or more than two similar failures of any duration, will be considered as a non-field-repairable malfunction. Upon completion of repairs by the PCSS, the SAT will be re-started from the date which the PCSS successfully corrected the malfunction(s) and the Owner and Engineer have accepted and signed off on the repairs.
- F. The PCSS shall perform repairs or replacement within 10 days in the event of rejection of any part or function of the hardware, software, field wiring and network configuration systems.
- G. All data base, process controller logic, and graphical interface system errors must be functioning as required per the specifications prior to the start of each test period. The 30-day test will not be considered successful until all data base points and logic functions are tested and verified to be correct.

- H. The total availability of the system shall be greater than 99.5 percent during this test period. Availability shall be defined as:  $\text{Availability in percent} = 100 * (\text{Total Testing Time} - \text{Down Time}) / \text{Total Testing Time}$
- I. Down times due to power outages or other factors outside the normal protection devices or backup power supplies provided shall not contribute to the availability test times above.
- J. Throughout the duration of the 30-day SAT, no software or hardware modifications shall be made to the system without prior approval from the Owner and Engineer.
- K. Upon successful completion of the 30-day operation test and subsequent review and approval of complete system final documentation, the system shall be considered substantially complete and the warranty period shall commence.
- L. Certification of Installation: Following successful completion of the 30-day test, the PCSS shall issue a Certification of Installation. Certification shall be on PCSS corporate letterhead and signed by an officer of the firm. Certification shall state that the process control system has been completed in conformance with plans and specifications. Certification shall be submitted to the Engineer as specified herein.

**END OF SECTION**

## **SECTION 40 50 30**

### **WATER QUALITY ANALYZERS**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. This section includes requirements for materials, testing, and installation of chlorine residual analyzers, and nitrate analyzers.

##### **1.2 RELATED WORK**

- A. Section 26 05 00– Basic Electrical Materials and Methods
- B. Section 26 05 53 – Electrical Identification
- C. Section 40 50 00 – Instrumentation and Controls General Provisions
- D. Section 40 50 01 – I&C Testing

##### **1.3 REFERENCES**

- A. International Society of Automation (ISA)

##### **1.4 SUBMITTALS**

- A. Submit shop drawings in accordance with the General Conditions.
- B. Submit manufacturer's catalog data and detail drawings showing dimensions, materials of construction, measurement range, electrical interfaces and protocols, and mounting requirements.
- C. Submit list of accessories and instrument options.

#### **PART 2 PRODUCTS**

##### **2.1 GENERAL**

- A. Wherever possible and feasible, components shall be of electronic solid-state design and systems shall utilize the same signal characteristics throughout each and all of the several systems; transmission signals shall be 4 mA to 20 mA. The combined power supply and transmitter loops shall, when tested with appropriate precision resistors, present a voltage signal of 1- to 5-volt DC.
- B. Signal isolators shall be provided where required.
- C. All products shall be UL listed.

## 2.2 AMPEROMETRIC FREE CHLORINE ANALYZER

- A. Provide a free chlorine analyzer package consisting of a measurement module and an analyzer/transmitter
- B. The measurement module shall have the following features and characteristics:
1. The flow cell shall have a built-in flow control device, check valve, sample flow alarm, temperature probe, and mesh filter screen.
  2. The probe shall utilize a bare electrode
  3. The measurement module shall provide measurement ranges of 0 – 100 µg/l, 0 - 200 µg/l, 0 – 500 µg/l, 0 – 1.00 mg/l, 0 – 2.00 mg/l, 0 – 5.00 mg/l, 0 – 10 mg/l, 0 – 20 mg/l, 0 – 50.0 mg/l, 0 – 100 mg/l and 0 – 200 mg/l.
  4. Accuracy: 10 µg/l or ±2% of full scale, whichever is greater
  5. Sensitivity: 10 µg/l or ±1% of full scale, whichever is greater
  6. Repeatability: 10 µg/l or ±2% of full scale, whichever is greater
  7. Stability: 2% of full scale per month
  8. Response Time: 90% of change within 20 seconds of sample entry
  9. The measurement module shall accommodate inlet pressures of 3 to 60 psig and temperatures of 41 to 122 degrees Fahrenheit.
- C. The analyzer/transmitter shall have the following features and characteristics:
1. Microprocessor-based solid-state circuitry designed for measurement of free or total chlorine, pH, or fluoride and transmission of proportional output signal linear to those analytes.
  2. Built-in simulator used in conjunction with front panel controls and display to simulate input parameters and to verify calibration, proper internal functioning of the analog-to-digital conversion, processing, outputs and setting up alarms.
  3. Built-in self-diagnostics: Error messages shall be presented on the display to indicate operational and equipment malfunctions. Operational errors shall include questionable calculation results, insufficient data, excessive input noise, input measurement, or calculated results out of range. Equipment problems shall include read-only memory fails check sum, random-access memory problem, identification error, card in wrong position, switch failure, wrong or no input card.
  4. Non-volatile EEPROM memory.
  5. The electronics shall include a 4” resistive touch screen for intuitive operation



6. The electronics shall include a color LED light stick that is placed in the flow cell via a cable lead – the LED stick can change color in case of warnings or alarms
  7. The electronics shall include smart operation features: programmable notification of a required calibration check and a required service interval – these notifications can be programmed to indicate a color change in the flow cell.
  8. Output signal: 4 x isolated 4-20 mA, 1000-ohm maximum load; galvanically isolated
  9. Digital input signal: 5 freely definable such as a low disinfectant level alarm, or chlorine gas container weight alarm
  10. External alarms: six electromechanical SPDT relays 3.15 A each chlorine and pH, user configurable latching or non-latching.
  11. Temperature: 5 to 50 degrees C. Provide automatic compensation for sample temperature.
  12. Enclosure: ABS, designed to NEMA 4X wall mounted.
  13. Power: 110 - 240 VAC  $\pm$  10 % 50/60 Hz or 24 VDC
  14. Accessories: Include sufficient, quantities for one-year operation assuming monthly calibration.
- D. Product and Manufacturer shall be the Depolox 400 M, as manufactured by Evoqua Water Technologies / Wallace and Tiernan.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Contractor shall require the manufacturer to furnish the services of qualified factory-trained servicemen to assist in the installation and calibration of the instrumentation specified herein.
- B. Install each item in accordance with manufacturer's recommendations. Sensors and analyzers/transmitters that require access for periodic calibration or maintenance shall be mounted so they are accessible while standing on the floor.
- C. All items shall be mounted and anchored using stainless steel hardware unless otherwise noted.
- D. All instruments shall be rigidly secured to walls, stands or brackets as required by the manufacturer and as shown.

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- E. Conform to all applicable provisions of the NEMA standards, NEC and local, State and Federal codes when installing the equipment and interconnecting wiring.

**END SECTION**

WATER QUALITY ANALYZERS  
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## **SECTION 40 51 20**

### **PLC HARDWARE AND SOFTWARE**

#### **PART 1 - GENERAL**

##### **1.01 SCOPE OF WORK**

- A. This Section includes programmable logic controllers (PLCs) for control of process equipment, process oriented machinery, and process systems.

##### **1.02 RELATED WORK**

- A. Refer to Section 40 50 00.
- B. Section 40 51 30 HMI System Software
- C. Section 40 51 50 Control Panels and Panel Equipment

##### **1.03 SUBMITTALS**

- A. Refer to Section 40 50 00.
- B. Product Data: For each type of PLC, include dimensions, mounting arrangements, and weights. Also, include manufacturer's technical data on features, performance, electrical ratings, characteristics, and terminal connections.
- C. Operation and Maintenance Data: Provide literature detailing routine maintenance requirements (if any) for each PLC component including:
  - 1. System specifications
  - 2. Electrical power requirements
  - 3. Application considerations
  - 4. Assembly and installation procedures
  - 5. Power-up procedures
  - 6. Programming procedures
  - 7. Explanation of internal fault diagnostics
  - 8. Shut down procedures
  - 9. Recommended spare parts list

##### **1.04 REFERENCE STANDARDS**

- A. ASTM D999-91: Vibration
- B. (CFR) Title 47, Part 18 (European EN 55011 (formerly CISPR 11))
- C. CSA Certification Class I, Division 2, Group A, B, C, D Hazardous or non-hazardous locations
- D. IEC 60068-2.1 Environmental testing – Part 2-1: Tests - Test A: Cold, 2.2 Environmental testing - Part 2: Tests. Tests B: Dry heat, 2.3, 2.6 Environmental testing - Part 2: Tests - Test Fc: Vibration (sinusoidal) and 2.27 Environmental testing. Part 2: Tests. Test Ea and guidance: Shock

- E. IEC 61000 Electromagnetic compatibility (EMC) - Testing and measurement techniques
  - 1. Part 4-2: Electrostatic discharge immunity test
  - 2. Part 4-3: Radiated, radio-frequency, electromagnetic field immunity test
  - 3. Part 4-4: Electrical fast transient/burst immunity test
  - 4. Part 4-5: Surge immunity test
  - 5. Part 4-6: Immunity to conducted disturbances, induced by radio-frequency fields
- F. IEC 61131-3: Programmable controllers - Part 3: Programming languages
- G. IEC 801-3: RFI Immunity
- H. IEC 801-5: Ground Continuity
- I. IEC 801-2: Electrostatic Discharge
- J. IEEE 472-1974/ANSI C37.90/90A-1974 (Surge Withstand) IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus
- K. MIL STD 461B CS02: RFI/EMI Susceptibility
- L. NEMA Pub No ICS2-230.42: Showering Arc Test
- M. NSTA Project 1A
- N. UL 508 and CSA Standard C22.2 No. 142 (Isolation Voltages)

#### 1.05 *QUALITY ASSURANCE*

- A. **Manufacturer Qualifications:** A qualified manufacturer shall be capable of providing training, parts, and coordination of emergency maintenance and repairs.
- B. The programmable controller and all of the corresponding components within the family of controller products shall be manufactured by a company who regularly manufactures and services this type of equipment.
- C. The manufacturer shall comply with ISO9001 standards for "Quality Systems- Model for Quality Assurance in Design/Development, Production, Installation, and Servicing".
- D. The manufacturer shall provide complete technical support for all of the products. This shall include factory or on-site training, regional application centers, local or factory technical assistance, and a 24/7/365 technical support phone service.

#### 1.06 *DELIVERY, STORAGE, AND HANDLING*

- A. Deliver PLC components in packaging designed to prevent damage from static electricity and physical damage.
- B. Store PLC equipment according to manufacturer requirements. At a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. Protect PLCs from exposure to dirt, fumes, water, corrosive substances, and physical damage. Also, protect the PLC from all forms of electrical and magnetic energy that could reasonably cause damage.

#### 1.07 *NOMENCLATURE AND IDENTIFICATION DEFINITIONS*

- A. AI: Analog Input
- B. AO: Analog Output
- C. Fixed I/O: A PLC style consisting of a fixed number of I/O, a processor, and a power supply all in one enclosure. Some fixed PLCs have limited expansion ability.
- D. CPU: Central Processing Unit
- E. DI: Discrete Input
- F. Distributed I/O: Hardware specially designed to function as Remote I/O.
- G. DO: Discrete Output
- H. HMI: Human-Machine Interface
- I. I/O Input and/or Output
- J. Modular: A PLC style consisting of cards that are assembled to comprise a complete unit. All I/O, CPU, and Power Supply are dedicated cards. Typically, these cards are inserted into a chassis.
- K. Master/Slave: Communication between devices in which one device, the master, controls all communications. The other devices, the slaves, respond only when queried by the master. Typically used in a Remote I/O application.
- L. Peer to Peer: Communication between two or more devices, typically PLC's, in which each device can control the communication exchange.
- M. PID: Control action, proportional plus integral plus derivative.
- N. PLC: Programmable Logic Controller
- O. Remote I/O: I/O that is located remotely from the processor. Remote I/O can communicate over a variety of communication protocols and can use standard rack based I/O, or special Remote I/O hardware referred to as Distributed I/O.
- P. SCADA: Supervisory Control and Data Acquisition

#### 1.08 *SPARE PARTS*

- A. Refer to Section 40 50 00.
- B. All spare parts shall be packaged to prevent damage during long-term storage. Identify all packages with indelible markings on the exterior describing contents.
- C. Provide complete ordering information including manufacturer, part number, part name, hardware and software revision levels, and equipment for which the part is to be used.

#### 1.09 *SPARE I/O*

- A. Each I/O drop and I/O location shall include at least 20 percent (minimum of four) points of each type required (AI, AO, DI, and DO) for future use. The spares shall be the same type of I/O modules supplied. Refer to Appendix 40 50 00-C&D PLC Input/Output list for signals designated as 'Dedicated Spares.' These signals shall count toward the 20 percent spare point requirement for each Remote I/O unit specified.

- B. Spare output points that require the use of an external relay shall include provision of that external relay.
- C. Regardless of the spare requirement, all installed unused points on all I/O modules shall be wired to terminal blocks in the order that they occur on the I/O modules. Unwired spares shall not be acceptable.

#### 1.10 MANUFACTURER SUPPORT

- A. Provide a written proposal for a manufacturer support agreement for PLC hardware and software for a minimum of 12 months starting at final completion of the project. The cost of this manufacturer support agreement shall be included in the Contract Price. The support agreement shall be executed in the name of, and for the benefit of, the OWNER. At a minimum, this agreement shall provide the OWNER with:
  - 1. 8 AM to 5 PM, 5 day per week manufacturer telephone support.
  - 2. Access to the manufacturer's technical support website.
  - 3. Software and firmware updates.
- B. At the beginning of the specified 12 month support agreement, the PCSS shall send a letter to the Engineer and OWNER, informing them of the expected termination date of the 12 month support agreement and costs for purchasing additional years of support.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. Provide Programmable Logic Controller equipment with the maximum memory available from the manufacturer for functional capacity (logic programming) to perform the specified sequence of operation with the scheduled input and output points.
- B. Processor Systems shall include processor, memory cards, power supplies, input/output modules, communication modules, redundancy modules, and remote interface modules as required to satisfy system requirements.
- C. Furnish products listed and classified by Underwriters Laboratories (UL), CSA, or FM approval as suitable for purpose specified and indicated.
- D. All equipment and devices, furnished hereunder, shall be designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production.
- E. All equipment furnished shall be designed and constructed so that in the event of power interruption the systems shall go through an orderly shutdown with no loss of memory, and resume normal operation without manually resetting when power is restored.
- F. The PLCs shall communicate between the operator workstation and field-mounted transducers, switches, controllers, and process actuators. Communications protocol

shall be completely transparent to process operators at the Human Machine Interface (HMI).

- G. The PLC shall be capable of stand-alone operation in the event of failure of the communication link to the HMI subsystem.
- H. Backup Processor Systems shall consist of two chassis with power supplies, each containing a processor, redundancy module and communications module(s). Remote chassis shall be provided with communication modules to meet I/O and communication requirements.
- I. Remote Input/Output Units shall include input/output modules, interface modules, communication modules, and power supply to meet system input and output requirements.
- J. Agency and environmental specifications:
  - 1. Electrical supply voltage to the PLC shall be 120 Vac, plus or minus .15 percent, 48-63Hz. PLC system power supplies shall be fused for overload protection.
  - 2. Vibration: 3.5 mm Peak-to-Peak, 5-9 Hz: 1.0G, 9-150\Hz. The method of testing is to be based upon IEC 68-2-6 and JIS C 0911 standards for vibration. The system is to be operational during and after testing. Vibration Rating of 2.0G maximum peak acceleration for 10 to 500Hz. in accordance with at least one of the following:
    - a. Installed rating: DIN rail mounted PLC: 10-57 Hz, amplitude 0.075 mm, acceleration 25-100 Hz, and
    - b. Panel or plate mounted PLC: 2-25 Hz, amplitude 1.6mm, acceleration 25-200 Hz.
    - c. In compliance with IEC 60068 and IEC 61131.
  - 3. Shock: 15G, 11 msec. The method of testing is to be based upon IEC 68-2-27 and JIS C 0912 standards for shock. The system is to be operational during and after testing.
  - 4. Temperature: All PLC hardware shall operate at an ambient temperature of 0 to +55 degrees C (+32 to +140 degrees F), with a storage ambient temperature rating of -25 to +70 degrees C (-40 to +185 degrees F).
  - 5. Relative Humidity: The Programmable Controller hardware shall function continuously in the relative humidity range of 30 percent to 95 percent non-condensing.
  - 6. Noise Immunity: The Programmable Controller system shall be designed and tested to operate in the high electrical noise environment of an industrial plant as governed by the following regulations: IEEE 472, IEC 801, MILSTD 461B, IEC 255-4, NEMA ICS 2-230.40, and ANSI/IEEE C-37.90A-1978.
  - 7. Altitude:
    - a. Operation: 0-6,500 feet
    - b. Storage: 0-9,800 feet
  - 8. Degree of protection: NEMA 1 (IP20)
  - 9. All products shall have corrosion protection.

- K. All major assemblies and sub-assemblies, circuit boards, and devices shall be identified using permanent labels or markings indicating:
1. Modules product type such as analog or digital
  2. Modules catalog number
  3. Modules major revision number
  4. Modules minor revision number
  5. Module manufacturer vendor
  6. Module serial number
- L. All necessary cables shall be included. All cables and connectors shall be as specified by the manufacturer. Cables shall be assembled and installed per the manufacturer recommendations.
- M. Manufacturers
1. Provide all PLCs from a single manufacturer. If the PLC manufacturer has authorized third party vendors to provide modules that are compatible with their platforms, then products manufactured by these authorized third party vendors will be acceptable.
  2. Provide the PLC system by one of the following, no others approved:
    - a. Rockwell Automation Allen Bradley Compactlogix Series.
- N. Central Processing Unit (CPU)
1. The CPU shall be, at a minimum, a 16-bit microprocessor that provides system timing and is responsible for scheduling I/O updates, with no user programming required to ensure discrete or analog update. It shall execute user logic programs, communicate with intelligent I/O modules, and perform on-line diagnostics. The CPU shall consist of a single module that solves application logic, stores the application program, stores numerical values related to the application processes and logic, and interfaces to the I/O.
  2. The CPU shall sample all the discrete and analog inputs and outputs including internal coils and registers, and service special function modules every scan. The CPU shall process the I/O with user program(s) stored in memory, then control the outputs based on the results of the logic operation.
  3. Supply the CPU with a battery-backed time of day clock and calendar.
  4. The CPU family shall allow for user program transportability from one CPU model to another.
- O. Diagnostics
1. The CPU shall perform on-line diagnostics that monitor the internal operation of the PLC. If a failure is detected, the CPU shall initiate system shutdown and fail-over. The following, at a minimum, shall be monitored: Memory failure, memory battery low, and general fault, communications port failure, scan time over run, I/O failure, and analog or special function I/O module failure.
  2. All diagnostic information shall be accessible to the host communications interfaces and to the PLC program.



3. The PLC shall have indicators and on board status area to indicate the following conditions:
  - a. CPU run
  - b. CPU error or fault
  - c. I/O failure or configuration fault.
  - d. Battery good
  - e. Communications indicator

P. Memory

1. The user program and data shall be contained in non-volatile battery backed memory. CPUs shall be provided with maximum available memory for logic programming storage, including on-board CPU memory and provision of available separate memory card modules.
2. Type: CMOS RAM program memory.
3. Memory Backup: lithium battery backup or Flash memory system capable of retaining all memory for a minimum of three months.
4. Backup Battery: The backup battery shall be capable of being replaced without disrupting memory integrity. Provide a visual indication of low battery voltage and a low battery alarm contact.
5. Flash Memory: Upon power loss, the PLC shall transfer internal memory to flash memory before the PLC powers down.
6. The operator should be able to backup volatile memory, including data and program logic onto a personal computer storage disk.
7. The operating system shall be contained in non-volatile firmware. The memory containing the operating system shall be field updateable via a separate update tool.

Q. Programming Environment

1. Programming port: The PLC shall utilize a serial USB or Ethernet port for programming.
2. On-Line programming: Application programs may be modified or stored while the CPU is running with minimal impact on the scan time.
3. Online programming including runtime editing
4. IEC 61131-3 programming languages supported: Ladder logic, function block, sequential function chart, and structure text.
5. Supply all hardware and software necessary to program the CPU in these languages.

R. Communication Ports

1. The CPU shall be expandable and supplied with additional modules to support the required communication interfaces.

S. Remote I/O Communications

1. The CPU shall be capable of communicating with up to 12 remote base locations at a combined distance of 2500 feet. The CPU shall automatically sample and update all local and remote I/O modules each scan cycle of the CPU.
2. The communication link between the CPU and any RIO chassis shall be as recommended by the PLC manufacturer. For racks located on a link of less than 2500 cable feet, the speed of the communications link shall be greater than 230K baud with RIO scan rate of less than 5 millisecond per RIO.
3. Diagnostic and equipment status information shall be available from each RIO.
4. It shall be possible to communicate with remote I/O racks or other PLCs via fiber optic cable.
5. The remote I/O system shall have available a remote input/output arrangement capable of operation at locations physically separated from the PLC CPU by up to 5,000 feet as detailed on the drawings.
6. Communication with the remote I/O arrangement shall be through cable as recommended by the PLC manufacturer and provided by the PLC system supplier under this specification section.

## 2.02 REDUNDANCY

- A. The PLC shall be supplied with all hardware and software required to produce a completely operational redundant system if shown in the Drawings. Redundancy shall be implemented using a minimum amount of user programming. Warm backup, which is not a standard offering from the PLC manufacturer, is not acceptable.
- B. The backup system shall consist of redundant controllers located in separate chassis.
- C. The back-up system shall provide bump-less, transparent, switchover for system outputs. All remote I/O shall maintain their last position until either communications is re-established or the remote I/O watchdog timer expires. Redundancy shall function regardless of which IEC 61131-3 programming languages is used for programming.
- D. Switchover between the on-line PLC and the back-up PLC shall occur within 100 milliseconds if any of the following conditions occurs in the on-line unit: Power failure, CPU fault, communications module fault, or change in the on-line unit's mode from RUN to PROGRAM.
- E. The switchover shall be transparent to any devices networked to the redundant controller chassis. Transparency shall include CPU IP address switching at the hardware-level and maintaining all serial communications upon switchover between the on-line PLC and the back-up PLC.
- F. The system shall automatically cross-load the primary controller's program to the secondary controller.
- G. System diagnostics and debugging tools shall be provided to assist in troubleshooting all redundancy equipment.

## 2.03 POWER SUPPLIES

- A. The PLC shall have chassis mounted power supplies to power the chassis backplane, and provide power for the processor and applicable modules.

- B. Power supplies shall have a clearly visible LED to indicate that the incoming power is acceptable and the output voltage is present.
- C. Power supplies shall feature over-current and over-voltage protection and should be designed to operate in most industrial environments without the need for isolation transformers.
- D. Power supplies shall be sized to accommodate the anticipated load plus 30%.
- E. DC power supplies shall be capable of handling ripple up to 2.4V peak to peak.
- F. AC Line Voltage rating of 85 to 265Vac, 47-63Hz
- G. The power supplies shall allow for brown outs of at least ½ of a cycle, a harmonic rate of 10%, and will sustain continuous operation through momentary interruptions of AC line voltage of 10ms or less.
- H. Automatically shut down the Programmable Controller system whenever its output power is detected as exceeding 125% of its rated power
- I. Provide surge protection, isolation, and outage carry-over up to 2 cycles of the AC line
- J. Redundant power supplies will comply with all the requirements of non-redundant power supplies in addition to the features stated below.
  - 1. The redundant power supplies shall be designed to share the current required by the chassis. In the event of a failure of one redundant power supply, the remaining supply will accommodate the entire load of the chassis without disruption to the chassis activity.
  - 2. Provide a failsafe fuse that is not accessible by the customer
  - 3. Provide a solid state relay connection to allow for failure annunciation when wired to an input module
  - 4. Diagnostic LED status indicators for power and redundancy

#### 2.04 CHASSIS

- A. All system and signal power to the CPU and support modules shall be distributed on the backplane. No interconnecting wiring between these modules via plug-terminated jumpers shall be acceptable.
- B. All system modules, main and expansion chassis shall be designed to provide for free air flow convection cooling. No internal fans or other means of cooling, except heat sinks, shall be permitted.
- C. All system modules including the processor shall be removable from the chassis or inserted in to the chassis while power is being supplied to the chassis without faulting the processor or damaging the modules.
- D. Modules shall be designed to plug into a chassis and to be keyed to allow installation in only one direction. The design must prohibit upside down insertion of the modules as well as safeguard against the insertion of a module into the wrong slot or chassis via an electronic method for identifying a module. Electronic keying shall perform an electronic check to insure that the physical module is consistent with what was configured.

## 2.05 DISCRETE INPUT AND OUTPUT MODULES

### A. General

1. Selection of discrete input and output modules types shall be based on maintaining functionality and connection to existing PLC/RIO signals.
2. Digital input and output modules shall provide ON/OFF detection and actuation.
3. The I/O count and type shall be as required to implement the functions specified plus an allowance for active spares, as noted below.
4. Modules shall be designed to be installed or removed while chassis power is applied.
5. Modules shall have indicators to display the status of communication, module health and input / output devices.
6. Each module shall have the following status indicators.
  - a. The On/Off state of the field device.
  - b. The module's communication status.
7. I/O modules shall contain a maximum of 16 points per module.

### B. Module Specifications (120Vac Isolated Input Module)

1. Nominal Input Voltage of 120V ac
2. On-State Current of 15mA @132V ac, 47-63Hz maximum
3. Maximum Off-State Voltage of 20V
4. Maximum Off-State Current of 2.5mA

### C. Module Specification (120Vac Isolated Output Module)

1. Each triac type discrete output shall have an associated interposing relay located in the same control panel. 120 VAC power for relay outputs shall be provided from the associated motor starter control circuit (when used with motor starters) or other 120 VAC source (when I/O is not associated with a particular motor starter).
2. Output Voltage Range of 74-265V ac, 47-63Hz
3. Output Current Rating:
  - a. Per Point - 2A maximum @ 30 degrees C; 1.0A maximum @ 60 degrees C; Linear Derating
  - b. Per Module - 5A maximum @ 30 degrees C; 4A maximum @ 60 degrees C; Linear Derating
4. Surge Current Per Point of 20A for 43ms each, repeatable every 2s @ 60 degrees C
5. Minimum Load Current of 10mA per point
6. Maximum On-State Voltage Drop of 1.5V peak @2.0A and 6V peak @load less than 50mA
7. Maximum Off-State Leakage of 3mA per point

D. Module Specifications (Contact Output Module)

1. Output Voltage Range of 10-265V ac, 47-63Hz
2. Output Current Rating:
  - a. Resistive - 2A @ 125V ac
  - b. Inductive - 2A Steady State, 15A make @125V ac
3. Power Rating (Steady State) of 250VA maximum for 125V ac inductive output
4. Maximum Off-State Leakage of 0 mA per point
5. Configurable States
  - a. Fault Per Point - Hold Last State, ON or OFF
  - b. Program Mode Per Point - Hold Last State, ON or OFF

2.06 ANALOG INPUT AND OUTPUT MODULES

A. General

1. Selection of analog input and output modules types shall be based on maintaining functionality and connection to existing PLC/RIO signals.
2. Analog input modules shall convert an analog signal that is connected to the module's screw terminals into a digital value. The digital value representing the magnitude of the analog signal shall be transmitted on the backplane. Analog output modules shall convert a digital value that is delivered to the module via the backplane into an analog signal on the module's screw terminals.
3. Modules shall be designed to be installed or removed while chassis power is applied.
4. Modules shall have indicators to display the status of communication, module health and input / output devices.
5. Each analog module shall provide both hardware and software indication when a module fault has occurred. Each module shall have an LED fault indicator and the programming software shall display the fault information.
6. Analog modules shall be software configurable through the I/O configuration portion of the programming software.
7. The following status shall be capable of being examined in ladder logic
  - a. Module Fault Word – Provides fault summary reporting.
  - b. Channel Fault Word – Provides under-range, over-range and communications fault reporting.
  - c. Channel Status Words – Provides individual channel under-range and over-range fault reporting for process alarm, rate alarms and calibration faults.
8. The 24 VDC power for analog instrument loops shall be provided as a part of the system. The 24 VDC power supply shall be derived from the 120 VAC input power circuit to the PLC. The field side of the 24 VDC power sources(s) shall have individual or grouped (of logically associated circuits) fusing and be provided with a readily visible, labeled blown fuse indicator.

B. Isolated Analog Input Module

1. Input Range of 0-20 mA
2. Resolution of approximately 16 bits across range
3. Input Impedance of Greater than 249 Ohms
4. Overvoltage Protection: 8V ac/dc with on-board current resistor
5. Normal Mode Rejection of 60dB at 60Hz
6. Common Mode Noise Rejection of 120dB at 60Hz, 100dB at 50Hz
7. Isolation Voltage
  - a. Channel to Channel - 100% tested at 1700V dc for 1s based on 250V ac
  - b. User to System - 100% tested at 1700V dc for 1s based on 250V ac

C. Isolated Analog Output Current Module

1. Output Current Range of 4 to 20 mA
2. Current Resolution of 12 bits across 20 mA
3. Open Circuit Detection – None
4. Output Overvoltage Protection - 24V ac/dc maximum
5. Output Short Circuit Protection – 20 mA or less (electronically limited)
6. Calibration Accuracy - Better than 0.1% of range from 4mA to 20 mA
7. Calibration Interval - 12 months typical

**2.07 COMMUNICATION INTERFACES**

A. The PLC will be capable of the following communication protocols as shown on the drawings:

1. 10BASE-T/100BASE-TX Ethernet communication.
2. Modbus (RTU and ASCII) for up to 247 slaves
3. Profibus DP for up to 126 slaves
4. Rockwell Automation's RIO Protocol
5. DeviceNet
6. Asynchronous serial link capable of communicating up to 19.2Kbps

B. When required provide an Communications Interface Module mounted in the chassis or the equivalent port directly on the CPU.

**2.08 PLC SOFTWARE**

A. The PCSS shall provide a PLC configuration and application development software package complete with documentation and disks. The PLC software package and associated licensing and/or activation shall be installed on the computers shown on the drawings.

B. The software package shall allow on-line/off-line program development, annotation, monitoring, debugging, uploading, and downloading of programs to the PLCs.

- C. All required hardware (including cables, cable adapters, etc.) for connection to PLCs shall be furnished.
- D. All software licenses required to achieve the functionality described in the Specifications shall be provided.
- E. The software package shall include a software license agreement allowing the Owner the right to use the software as required for any current or future modification, documentation, or development of the PLCs furnished for this project.
- F. The software provided shall be capable of the following IEC 61131-3 functions:
  - 1. Ladder logic.
  - 2. Function block.
  - 3. Sequential function chart.
  - 4. Structure text.
- G. In addition to the above editors, an add-on instruction editor shall work with any of the above-mentioned editors to create custom reusable function blocks. This software shall allow any of the derived function blocks to be modified on-line.
- H. The software shall be Microsoft Windows-based and run on the supplied computers.
- I. The software shall include a security feature to prevent unauthorized personnel from modifying and downloading the programs.
- J. Provide an I/O simulator that allows the PLC application load program to be tested on a PC with simulated analog and digital inputs and outputs, allowing I/O testing and debugging to be performed in a safe, isolated environment without the need for running the PLC CPU and process I/O boards.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL INSTALLATION**

- A. Maintain area free of dirt and dust during and after installation of programmable controller products.
- B. Anchor PLCs within enclosures as recommended by the PLC manufacturer.
- C. Ventilation slots shall not be blocked, or obstructed by any means.
- D. Examine areas, surfaces, and substrates to receive PLCs for compliance with requirements, installation tolerances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Install in accordance with manufacturer's instructions.
- F. Unload, unpack and transport equipment to prevent damage or loss.
- G. Replace damaged components as directed by Engineer.

#### **3.02 PANEL LAYOUT**

- A. Coordinate size and configuration of enclosure to meet project requirements. Drawings indicate maximum dimensions for PLCs, minimum clearances between PLCs, and adjacent surfaces and other items.

- B. Comply with indicated maximum dimensions and clearances, or with PLC vendors required distances if they are greater than the distances indicated.
  - 1. Provide spacing around PLC as required by the PLC manufacturer to insure adequate cooling. Insure that the air surrounding the PLC has been conditioned to maintain the required temperature and humidity range.
  - 2. Wires entering and exiting PLC components shall be sized to comply with the PLC manufacturers requirements. Doors on all components shall be able to be fully closed when all the wires are installed.
  - 3. For chassis mounted PLCs, no wiring, wire ducts, or other devices shall obstruct the removal of cards from the rack.
  - 4. PLC lights, keys, communication ports, and memory card slots shall be accessible at all times. Lights shall be visible at all times when enclosure door is opened.
- C. Control panel designer shall provide independent line fuses or circuit breakers, per the PLC manufacturer recommendation, for each power supply, input module, output module, and other modules with separately derived power requirements.
- D. Control panel designer shall insure that communication signals, 4-20mA signals (including those with embedded HART), are properly conditioned for the PLC and protected from all sources of radiated energy or harmonics.
- E. Each PLC (including all I/O) shall be powered from an UPS power conditioning system.
- F. Where multiple mechanical components are provided for process redundancy, their field connections to I/O modules shall be arranged such that the failure of a single module will not disable all mechanical components associated with the process redundancy (e.g., inputs and outputs for redundancy device 1 shall reside on different modules than the inputs and outputs for redundancy device 2, etc.), irrespective of the number of used points resulting from this configuration.
- G. Provide all required cables, cords, and connective devices for interface with other control system components.

**END OF SECTION**



## **SECTION 40 51 30**

### **HUMAN MACHINE INTERFACE (HMI) HARDWARE**

#### **PART 1 - GENERAL**

##### **1.01 SCOPE OF WORK**

- A. Furnish all labor and materials required and installed. Complete as shown on the Drawings and as specified herein.
- B. The PCSS shall furnish the labor and materials required to install and bring into operation HMI hardware.

##### **1.02 RELATED WORK**

- A. Refer to Division 26 specifications.
- B. Refer to Section 40 50 00.

##### **1.03 SUBMITTALS**

- A. Refer to Section 40 50 00.

##### **1.04 REFERENCE STANDARDS**

- A. Refer to Section 40 50 00.

##### **1.05 QUALITY ASSURANCE**

- A. Refer to Section 40 50 00.

##### **1.06 SYSTEM DESCRIPTION**

- A. Provide all HMI hardware as identified in the Contract Documents.
- B. Provide the following equipment at these locations:
  - 1. MCC1            15" Panelview
  - 2. MCC2            15" Panelview
  - 3. LCP-100        7" Panelview
  - 4. LCP-930        7" Panelview
  - 5. LCP-980        7" Panelview
  - 6. LCP-1090       7" Panelview
  - 7. LCP-1100       7" Panelview
  - 8. LCP-1400       7" Panelview
  - 9. LCP-2000       7" Panelview

##### **1.07 DELIVERY, STORAGE, AND HANDLING**

##### **1.08 PROJECT/SITE REQUIREMENTS**

A. Refer to Section 40 50 00.

#### 1.09 MAINTENANCE

A. Refer to Section 40 50 00.

#### 1.10 WARRANTY

A. Refer to Section 40 50 00.

#### 1.11 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 40 50 00.

### **PART 2 - PRODUCTS**

#### 2.01 HARDWARE

##### A. Manufacturer

1. Rockwell Series 2711P, Panelview Plus 7 Standard or approved equal.

##### a. 15-INCH DISPLAY

- 1) The operator interface terminal shall be Allen-Bradley Series 2711P, PanelView Plus 7 Standard 1500.
- 2) The display size shall be 304 mm wide by 228 mm high.
- 3) The operator display/input shall be a color graphic display with touch screen input.

##### B. General

1. Provide Human Machine Interfaces located on the face of the PCM or vendor control panel as indicated on the Drawings or as scheduled herein.
2. NEMA 4X rated where located outdoors.
3. NEMA 12 rated where located indoors.
4. Human Machine Interface consists of graphical display screen with operator input capabilities.
5. Capable of stand-alone operation in conjunction with 1 PLC.
6. Equipped with data network communication capabilities.

##### C. Display

1. Type: Color, TFT LCD screen.
2. Easy display viewing at any angle in various ambient light conditions.
3. Operator Input: Configurable touch screen.
4. Screen Update speed: The screen update speed and screen change speed less than 1 second.
5. Provide following features for outdoor use:
  - a. Anti-glare screen overlay.

- b. Luminescence: Minimum 1000 Nits

D. Graphic Configuration:

- 1. Easily configured graphics by:
  - a. Portable laptop computer both locally and via the PLC data network.
  - b. SCADA Engineer's Console via the PLC data network.
- 2. In cordance with Section 40 96 32.

E. Memory:

- 1. 128 MB RAM.

F. Communications:

- 1. RS232.
- 2. Ethernet.

G. Environment:

- 1. Operating Temperature: 0 to 55 degrees Celsius.
- 2. Relative Humidity: 5 to 95 percent.

H. Electrical:

- 1. Power Supply:
  - a. 24 VDC.

I. ACCESSORIES

- 1. Provide sun shield for outdoor installations.

**2.02 SOFTWARE**

A. Manufacturer

- 1. Rockwell FactoryTalk View SE or approved equal.

B. General

- 1. Refer to Section 40 52 80.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

- A. All components of the control system including all data network cables are the installation responsibility of the contractor unless specifically noted otherwise.

**END OF SECTION**

## **SECTION 40 51 50**

### **CONTROL PANELS AND PANEL MOUNTED EQUIPMENT**

#### **PART 1 - GENERAL**

##### **1.01 SCOPE OF WORK**

- A. Refer to Section 40 50 00.
- B. Furnish and install control panels and panel mounted equipment as specified herein and shown on the Drawings.
- C. All new panels and panel components shall match existing equipment makes and models wherever possible, so that system additions can be most easily integrated with respect to operation and maintenance training, spare parts inventory, and service contracts. Even when exact matches are not possible, equipment furnished must be fully compatible with the existing system. Color, size, and material of new panels should conform to that of existing panels.
- D. Furnish the following panels and consoles. Each panel shall be supplied with full sub-panels and side panels as required.

##### **1.02 RELATED WORK**

- A. Refer to Section 40 50 00.

##### **1.03 SUBMITTALS**

- A. Refer to Section 40 50 00.

##### **1.04 COORDINATION MEETINGS**

- A. Refer to Section 40 50 00.

##### **1.05 REFERENCE STANDARDS**

- A. Refer to Section 40 50 00.

##### **1.06 QUALITY ASSURANCE**

- A. Refer to Section 40 50 00.

##### **1.07 DELIVERY, STORAGE AND HANDLING**

- A. Refer to Section 40 50 00.

##### **1.08 NOMENCLATURE AND IDENTIFICATION**

- A. Refer to Section 40 50 00.

##### **1.09 MAINTENANCE**

- A. Refer to Section 40 50 00.

##### **1.10 SPARE PARTS AND TEST EQUIPMENT**

- A. Refer to Section 40 50 00.

#### 1.11 *WARRANTY*

- A. Refer to Section 40 50 00.

### **PART 2 - PRODUCTS**

#### 2.01 *GENERAL*

- A. Refer to Section 40 50 00.

#### 2.02 *LIGHTNING/SURGE PROTECTION*

- A. Refer to Section 40 50 00.

#### 2.03 *CONTROL PANEL GENERAL REQUIREMENTS*

- A. The dimensions within this Section and on the Contract Drawings are for general reference only. Ensure that final enclosure sizing and panel arrangements accommodate all required equipment for a fully integrated and operational system as specified herein and in the Contract Documents.
- B. Each control panel and terminal cabinet shall bear the UL label. The UL label shall apply to the enclosure, the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses and any other equipment necessary to achieve compliance with UL 508 requirement. The Drawings do not detail all UL 508 requirements.
- C. All panel doors shall have a lock installed in the door handle, or a hasp and staple for padlocking. Locks for all panels provided under this Contract shall be keyed alike.
- D. The devices designated for rear-of-panel mounting shall be arranged within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment. Heat generating devices such as power supplies shall be located at or near the top of the panel.
- E. The panels shall be completely fabricated, instruments and devices installed and wired at the PCSS's facility.
- F. All components shall be mounted in a manner that shall permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component mounting shall be oriented in accordance with manufacturer's recommendations. The internal components shall be identified with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component in accordance with the drawing, specifications, and PCSS's data.
- G. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.

#### H. Nameplates

1. All panels and panel devices shall be supplied with suitable nameplates, which identify the panel and individual devices as required. Unless otherwise indicated, each device nameplate shall include up to three lines with the first line containing the device tag number as shown on the drawings, the second line containing a functional description (e.g., Recirculation Pump No. 1), and the third line containing a functional control description (e.g., Start).
2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings, nameplates shall be 3/32-inch thick, black and white, Lamicoid with engraved inscriptions. The letters shall be Black [White] against a White [Black] background unless otherwise noted. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.
3. Nameplate fasteners and mounting shall be epoxy adhesive or stainless steel screws for cabinet mounted nameplates
4. For every panel, provide a panel nameplate with a minimum of 1" high letters. Provide legend plates or 1-in by 3-in engraved nameplates with 1/4-in lettering for identification of door mounted control devices, pilot lights, and meters.
5. Single lamicoid nameplates with multiple legends shall be used for grouping of devices such as selector switches and pilot lights that relate to one function.

#### I. Mounting Elevations

1. ISA Recommended Practice RP60.3 shall be used as a guide in layout and arrangement of panels and panel mounted components. Dimensions shall account for all housekeeping pads that panels will sit on once they are installed.
2. Centerline of indicators and controllers shall be located no lower than 48-inches or higher than 66-inches above the floor on a panel face.
3. Centerline of lights, selector switches, and pushbuttons shall be located no lower than 32-inches or higher than 70-inches above the floor on a panel face.
4. Tops of annunciators shall be located no higher than 86-inches above the floor on a panel face.
5. Installation of panel components shall conform to component manufacturers' guidelines.

### 2.04 PANEL MATERIALS AND CONSTRUCTION

#### A. Structure and Enclosure

1. Panels shall be of continuous welded-steel or FRP construction as shown on the Panel Schedule. Provide angle stiffeners as required on the back of the panel face to prevent panel deflection under instrument loading or operation. Internally the panels shall be supplied with a structural framework for instrument support purposes and panel bracing. The internal framework shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.
2. Each panel shall be provided with full height, fully gasketed access doors where shown. Doors shall be provided with a three-point stainless steel latch and heavy duty stainless steel locking handle. Panel access doors shall be provided with full

length, continuous, piano type stainless steel hinges with stainless steel pins. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments.

3. The panels, including component parts, shall be free from sharp edges and welding flaws. Wiring shall be free from kinks and sharp bends and shall be routed for easy access to other components for maintenance and inspection purposes.
4. The panel shall be suitable for top and bottom conduit entry as required by the Electrical Drawings. For top mounted conduit entry, the panel top shall be provided with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts, and other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.
5. All panels in indoor, dry, non-corrosive environments shall be NEMA 12 unless otherwise noted. All panels in outdoor, wet, and non-chemically corrosive environments shall be NEMA 4 unless otherwise noted. Panels in chemically corrosive environments shall be NEMA 4X unless otherwise noted. All panels located in a hazardous location shall be rated for the type of hazard (e.g., NEMA 7 for Class 1, Division 1).

**B. Freestanding and Floor-Mounted Vertical Panels**

1. Freestanding and floor-mounted vertical panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of sheet steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated panels shall be constructed of 316 stainless steel. Front panels or panels containing instruments shall be not less than 10 gauge stretcher leveled sheet steel, reinforced to prevent warping or distortion.

**C. Wall and Unistrut Mounted Panels**

1. All wall and Unistrut mounted panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of not strength. All NEMA 4X rated wall mounted panels shall be constructed of 316 stainless steel.

**D. Finish Requirements**

1. All sections shall be descaled, degreased, filled, ground and finished. The enclosure when fabricated of steel shall be finished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels will not require a paint finish.
2. The panels shall have edges ground smooth and shall be sandblasted and then cleaned with a solvent. Surface voids shall be filled and ground smooth.
3. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two-

component type epoxy enamel. A final sanding shall be applied to the intermediate exterior coat before top coating.

4. Apply a minimum of two coats of flat white lacquer on the panel interior after priming.
  5. Unless otherwise noted, the finish exterior colors shall be ANSI 61 gray with a textured finish.
- E. Print storage pockets shall be provided on the inside of each panel. The storage pockets shall be steel, welded on to the door, and finished to match the interior panel color. The storage pocket shall be sufficient to hold all of the prints required to service the equipment, and to accommodate 8.5 inch by 11 inch documents without folding.
- F. Where specified on the Panel Schedule, a folding shelf shall be provided on the inside of the door on all free-standing and floor-mounted panels. The shelf shall be suitable for a laptop computer and shall be placed such that an open laptop computer does not interfere with any door-mounted devices. The folded shelf shall not interfere with any internal panel components when the door is closed. The folding shelf shall automatically lock in the horizontal position when raised. The folding shelf shall be approximately 18 inches wide by 12 inches deep and shall have a minimum distributed load rating of 100 pounds. All parts shall be made of heavy gauge steel and shall be painted white or finished to match the interior panel color.

## 2.05 ENVIRONMENTAL CONTROL

- A. All panels shall be provided with louvers, sun shields, heat sinks, forced air ventilation, or air conditioning units as required to prevent temperature buildup inside of panel. The internal temperature of all panels shall be regulated to a range of 45 Deg F to 104 Deg F under all conditions. Under no circumstances shall the panel cooling or heating equipment compromise the NEMA rating of the panel.
- B. PCSS shall submit heat dissipation calculations for every control panel.
- C. Except for panels mounted with their backs directly adjacent to a wall, louvers shall be in the rear of the panels, top and bottom, and shall be stamped sheet metal construction.
- D. For panels mounted with their backs directly adjacent to a wall, louvers shall be on the sides.
- E. Forced air ventilation fans, where used, shall provide a positive internal pressure within the panel, and shall be provided with washable or replaceable filters. Fan motors shall operate on 120-volt, 60-Hz power.
- F. For panels with internal heat that cannot be adequately dissipated with natural convection and heat sinks, or forced air ventilation, an air conditioner shall be provided.
- G. Provide custom fabricated sun shields for all outdoor panels in accordance with the following requirements:
1. Sun shields shall be fabricated from minimum 12 gauge aluminum. Units shall be designed, fabricated, installed, and supported to fully cover and shade the top, sides and back of the enclosure, and to partially shade the front panel of the enclosure, from direct exposure to sunlight from sunrise to sunset.



2. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure.
  3. Sun shields shall not be attached directly to the enclosure by drilling holes through, or welding studs to, the enclosure surfaces, and shall be designed and mounted to provide a minimum 3-inch air gap all around the enclosure for air circulation and heat dissipation.
  4. The top section of all sun shields shall be sloped at a minimum angle of 5 degrees from horizontal. For wall mounted enclosures, the top section shall slope downward away from the wall and towards the front of the enclosure. For free standing, floor mounted and frame mounted enclosures the top section shall slope downward towards the back side of the enclosure.
  5. The front edge of the top section of all sun shields shall incorporate a narrow and more steeply sloped drip shield segment which sheds water away from the front of the enclosure and prevents it from dripping or running directly onto the front panel of the enclosure.
  6. All seam welds used in sun shield fabrication shall be continuous and shall be ground smooth.
  7. All exposed corners, edges and projections shall be smooth rounded or chamfered to prevent injury.
- H. All outdoor enclosures and enclosures located in unheated areas indoors or in areas subject to humidity and moisture shall be provided with an integral heater, fan, and adjustable thermostat to reduce condensation and maintain the minimum internal panel temperature. Mount the unit near the bottom of the enclosure with discharge away from heat-sensitive equipment. Heater shall be Hoffman DAH [100] [200] [400] [800] Watts, [115] [230] Volt, 50/60 HZ or equal.

## 2.06 CONTROL PANEL - INTERNAL CONSTRUCTION

### A. Internal Electrical Wiring

1. All interconnecting wiring shall be stranded, type MTW, and shall have 600 volt insulation and be rated for not less than 90 degrees Celsius. Wiring for systems operating at voltages in excess of 120 VAC shall be segregated from other panel wiring either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Panel layout shall be developed such that technicians shall have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.
2. Power distribution wiring on the line side of fuses or breakers shall be 12 AWG minimum. Control wiring on the secondary side of fuses shall be 16 AWG minimum. Electronic analog circuits shall utilize 18 AWG shielded, twisted pair, cable insulated for not less than 600 volts.
3. Power and low voltage DC wiring systems shall be routed in separate wireways. Crossing of different system wires shall be at right angles. Different system wires routed parallel to each other shall be separated by at least 6-inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs shall not be filled to more than 60 percent visible fill.

4. Terminations
  - a. All wiring shall terminate onto single tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct wiring between field equipment and panel components is not acceptable.
  - b. Multi-level terminal blocks or strips are not acceptable.
  - c. Terminal blocks shall be arranged in vertical rows and separated into groups (power, AC control, DC signal). Each group of terminal blocks shall have a minimum of 25 percent spares.
  - d. Terminal blocks shall be the compression type, fused, unfused, or switched as shown on the Contract Drawings or specified elsewhere in Division 40.
  - e. Discrete inputs and outputs (DI and DO) shall have two terminals per point with adjacent terminal assignments. All active and spare PLC and controller points shall be wired to terminal blocks.
  - f. Analog inputs and outputs (AI and AO) shall have three terminals per shielded pair connection with adjacent terminal assignments for each point. The third terminal is for shielded ground connection for cable pairs. Ground the shielded signal cable at the PLC cabinet. All active and spare PLC and controller points shall be wired to terminal blocks.
  - g. Wire and tube markers shall be the sleeve type with heat impressed letters and numbers.
  - h. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free standing panels, or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.
  - i. Circuit power from the SCADA cabinet out to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards shall be isolated with an isolating switch terminal block with flip cover that is supplied with a dummy fuse. Isolation switch block shall be an Allen Bradley Model 1492-H7 or equal. One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.
  - j. All PLC discrete outputs to the field shall be isolated with an isolating fuse switch terminal block with a flip cover and a neon blown fuse indicator. The single circuit fusible terminal block shall be an Allen Bradley 1492-H4 or equal.
5. All wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection, shall be clearly identified as such.
6. All wiring shall be clearly tagged and color coded. All tag numbers and color coding shall correspond to the panel wiring diagrams and loop drawings prepared by the PCSS. All power wiring, control wiring, grounding, and DC wiring shall utilize different color insulation for each wiring system used. The color coding scheme shall be:
  - a. Incoming 120 VAC Hot - Black
  - b. 120 VAC Hot wiring downstream of panel circuit breaker – Red

- c. 120 VAC Hot wiring derived from a UPS system – Red with Black stripe
  - d. Three phase power – Brown, Orange, Yellow, and Green ground or as specified in Division 26.
  - e. 120 VAC neutral - White
  - f. Ground - Green
  - g. DC power or control wiring – Blue
  - h. DC analog signal wiring – Black (+), White (-)
  - i. Foreign voltage – Yellow
7. Provide surge protectors on all incoming power supply lines at each panel per the requirements of Section 40 50 00.
  8. Each field instrument furnished under Division 40 and shown on the Drawings as deriving input power from the control panel(s) shall have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication. All instruments requiring 120VAC power shall be powered from the UPS source in the panel where the instrument signals lands.
  9. Provide 24VDC power supplies to power field instruments and panel devices. 24VDC power supplies shall be as specified in this Section.
  10. Use of adhesive backed cable tie mounts is not acceptable. Cable ties shall be permanently fixed to the panel structure, as needed for controlling cable routing within the panel.
  11. Wiring trough for supporting internal wiring shall be plastic type with snap-on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.
  12. Each panel shall have a single tube, fluorescent light fixture, 20 Watt in size, mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp.
  13. Each panel shall have a specification grade duplex convenience receptacle with ground fault interrupter, mounted internally within a stamped steel device box with appropriate cover. Convenience receptacle shall not be powered from a UPS and shall be protected by a dedicated fuse or circuit breaker.
  14. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.
  15. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.
  16. Each panel shall have control, signal, and communication line surge suppression in accordance with Section 40 50 00.
  17. All microprocessor-based electronic devices in the panel that are powered by 120VAC shall be powered by the UPS (refer to appropriate Section in Division 40).

18. Each panel shall be provided with a circuit breaker to interrupt incoming power. Provide a minimum of two (2) spare 20-amp breakers.
  19. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. shall be in compliance with the requirements of Division 26.
- B. Pneumatic Tubing
1. Refer to Section 40 50 00.
  2. Pneumatic tubing shall be a minimum of 1/4-inch O.D. 316 stainless steel with compression fittings. All tubing shall be rigidly supported and run in horizontal or vertical planes.
  3. All pneumatic equipment shall be provided with separate shut-off valves. Flexible polyethylene tubing shall be used on all devices mounted on hinged doors, etc.
  4. A screened vent shall be provided on all enclosures using pneumatic instruments.
  5. All pneumatic tubing shall be routed in separate bundles or wireways, and shall be separated from all electrical wiring by a minimum of 3-inches.
- C. Relays not provided under Division 26 and required for properly completing the control function specified in Division 40, Division 26, or shown on the Drawings shall be provided under this Section.
- D. The orientation of all devices including PLC and I/O when installed shall be per the manufacturer's recommendations. No vertical orientation of PLC racks shall be allowed unless specifically indicated by the manufacturer as an acceptable mounting alternative and also approved by the engineer.
- E. Purge system for enclosures located in hazardous areas.

## 2.07 ELECTRICAL COMPONENTS

- A. Refer to Division 26.
- B. The control panel shall be provided with a main power circuit breaker and individual fuses for each 120VAC and 24VDC logical circuit.
- C. All operating control devices and instruments shall be securely mounted on the exterior door. All controls shall be clearly labeled to indicate function and shall be in accordance with the electrical area classification indicated on the Contract Drawings.
- D. The control panel shall be provided with a lightning and surge protection unit on the line side of the main circuit breaker. Unit shall be 600 Volt, 3 Phase, General Electric "Tranquell" Series, or equal.

## 2.08 PILOT TYPE INDICATING LIGHTS

- A. Type: Energy efficient Solid State LED Lamps.
- B. Functional:
1. Units shall be provided with low voltage LED lamps suitable for the voltage supplied.
  2. Lights supplied with 120V AC power shall have integral reduced voltage transformers.

3. Lamps shall be replaceable from the front of the unit.

C. Physical:

1. Lens color:
  - a. Running, on, open – Red.
  - b. Stopped, off, closed – Green.
  - c. Alarm – Amber.
  - d. White - Power on
  - e. Blue - All other status indications not covered by the above
  - f. Lens caps shall be approximately 0.46 inch diameter. Provide legend faceplates engraved to indicate the required function of each device; NEMA rating - 4X.

D. Manufacturer(s):

1. Cutler-Hammer.
2. Allen Bradley.
3. Equal.

## 2.09 *SELECTOR SWITCHES AND PUSHBUTTONS*

A. Type:

1. Control devices shall be heavy-duty oil tight type with stackable contact blocks.

B. Functional:

1. Provide contact arrangement and switching action as required for the control system specified.

C. Physical:

1. For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide silver sliding contacts rated 5 amps at 125 VDC, for electronic (millivolt/ milliamp) switching provide contacts rated lamp at 28 VDC.
2. Pushbuttons shall have flush type operators.
3. Selector switches shall have knob or wing lever operators; NEMA rating - 4X; Provide legend plates denoting switch/pushbutton position/ function.

D. Manufacturer(s):

1. Cutler-Hammer.
2. Allen Bradley.
3. Equal.

## 2.10 *POTENTIOMETER*

A. Type:

1. Device shall be heavy-duty 30 mm oil tight type.

B. Functional:

1. 270 degree dial
  2. Rated for 1,000 ohms.
- C. Physical:
1. Mounting: Suitable for panel mounting
  2. NEMA 4X rating; escutcheon plates scaled in engineering units.
- D. Manufacturer(s):
1. Allen Bradley Co.
  2. Cutler-Hammer.
  3. Equal.

#### 2.11 *GENERAL PURPOSE RELAYS AND TIME DELAYS*

- A. Type:
1. General purpose plug-in type.
- B. Functional:
1. Contact arrangement/function shall be as required to meet the specified control function; mechanical life expectancy shall be in excess of 10 million.
  2. Duty cycle shall be rated for continuous operation; Units shall be provided with integral indicating light to indicate if relay is energized.
  3. Solid state time delays shall be provided with polarity protection (DC units) and transient protection.
  4. Time delay units shall be adjustable and available in ranges from .1 second to 4.5 hours.
- C. Physical:
1. For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide contacts rated 5 amps at 28 VDC, for electronic (milliamp/millivolt) switching applicator provide gold plated contacts rated for electronic service; relays shall be provided with dust and moisture resistant covers.
- D. Options/Accessories Required:
1. Provide mounting sockets with pressure type terminal blocks rated 300 volt and 10 amps.
  2. Provide mounting rails/holders as required.
- E. Manufacturer(s):
1. IDEC.
  2. Allen Bradley.
  3. Potter & Brumfield.
  4. Equal.

#### 2.12 *SIGNAL RELAY SWITCHES (CURRENT TRIPS)*

- A. Type:
  - 1. Solid state, ASIC technology, electronic type.
- B. Functional:
  - 1. Input: 4-20 mA.
  - 2. Output: Isolated contact output, double pole double throw, rated 5 amps at 120 VAC.
  - 3. Accuracy: 0.1 percent.
  - 4. Protection: Provide RFI protection.
  - 5. Deadband: Adjustable between 0.1 and 5.0 percent of span.
  - 6. Set point Adjustment: Single Point alarms shall be adjustable to trip on rising or falling input signal, dual point alarms shall be adjustable to trip on rising and falling input signals.
  - 7. Repeatability: Trip point repeatability shall be at least 0.1 percent of span.
- C. Physical:
  - 1. Mounting: DIN rail.
- D. D. Manufacturer(s):
  - 1. Action Instruments Slim Pak.
  - 2. Acromag.
  - 3. Equal.

### 2.13 *SIGNAL ISOLATORS/BOOSTERS/CONVERTERS*

- A. Type:
  - 1. Solid state, ASIC technology; electronic type.
- B. Functional:
  - 1. Accuracy: 0.15 percent.
  - 2. Inputs: Current, voltage, frequency, temperature, or resistance as required.
  - 3. Outputs: Current or voltage as required.
  - 4. Isolation: There shall be complete isolation between input circuitry, output circuitry, and the power supply.
  - 5. Adjustments: Zero and span adjustment shall be provided.
  - 6. Protection: Provide RFI protection.
- C. Physical:
  - 1. Mounting: DIN rail.
- D. Manufacturer(s):
  - 1. Action Instruments Slim Pak.
  - 2. Acromag.

3. Equal.

#### 2.14 *SIGNAL SELECTORS, COMPUTATION, AND CONDITIONING RELAYS*

A. Type:

1. Solid state, ASIC technology, electronic type.

B. Functional:

1. Inputs: 4-20 mA.
2. Outputs: 4-20 mA.
3. Protection: Provide RFI protection.
4. Operation: The relay shall multiply, add, subtract, select, extract the square root, or perform the specified conditioning/ computation function required. All inputs shall be able to be individually rescaled and biased as Required.
5. Isolation: All inputs, outputs, and power supplies shall be completely isolated.
6. Accuracy: 0.35 percent of span.
7. Adjustments: Multi turn potentiometer for zero, span, scaling, and biasing.

C. Physical:

1. Mounting: DIN rail.

D. Manufacturer(s):

1. Action Instruments Slim Pak.
2. Acromag.
3. Equal.

#### 2.15 *INTRINSICALLY SAFE RELAYS*

A. Type:

1. Relays shall be of the solid state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe usage in hazardous areas.

B. Options Required:

1. Relays shall match power supply provided.
2. Relays shall be located in non-hazardous areas.

C. Manufacturer(s):

1. Consolidated Electric.
2. Gems Safe-Pak.
3. Warrick Controls.
4. R. Stahl, Inc.
5. Equal.

#### 2.16 *EMERGENCY ALARM BEACON AND AUDIBLE HORN*



- A. Beacon alarm light:
  - 1. Type:
    - a. Beacon alarm light.
  - 2. Physical:
    - a. Beacon alarm light for building exterior mounting shall be 120 VAC, flush mounted, weatherproof construction.
    - b. A 750,000-candle power xenon strobe tube and red polycarbonate lens.
  - 3. Manufacturer(s):
    - a. Federal Signal.
    - b. Edwards.
    - c. Wheelock.
    - d. Equal.
- B. Alarm Horn:
  - 1. Type:
    - a. Alarm horn shall be vibrating type for 120 Volts, 60 Hz.
  - 2. Manufacturer(s):
    - a. Federal Signal Corp.
    - b. Edwards Co.
    - c. Benjamin.
    - d. Equal.

#### **2.17 INTRINSIC SAFETY BARRIERS (FOR 2-WIRE TRANSMITTER SYSTEMS)**

- A. Intrinsic safety barriers shall be passive devices requiring no external voltage supply and supplied with series resistors, series fuse and shunt zener diodes to limit the transfer of energy to levels required by intrinsically safe protection between safe and hazardous locations.
- B. Unit shall be Factory Mutual approved and certified for use in accordance with National Fire Protection Association (NFPA 493).
- C. Manufacturer(s):
  - 1. P&F.
  - 2. Gems.
  - 3. Unitech.
  - 4. Equal.

#### **2.18 24 VDC POWER SUPPLIES**

- A. Provide a 24 VDC power supply in the control panel to power field instruments, panel devices, etc., as required. Equip the power supply with a power on/off circuit breaker.
- B. The 24 VDC power supply shall meet the following requirements:

1. Input power: 115 VAC, plus or minus 10 percent, 60 Hz.
  2. Output voltage: 24 VDC.
  3. Output voltage adjustment: 5 percent.
  4. Line regulation: 0.05 percent for 10 volt line change.
  5. Load regulation: 0.15 percent no load to full load.
  6. Ripple: 3 mV RMS.
  7. Operating temperature: 32 to 140 degrees Fahrenheit.
- C. Size the 24 VDC power supply to accommodate the design load plus a minimum 25 percent spare capacity.
- D. If power supply on/off status signal is shown, provide a relay contact (internal to the power supply or external if the power supply is not so equipped) to indicate on/off status of the power supply.
- E. Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.
- F. Mount the 24 VDC power supply such that dissipated heat does not adversely affect other panel components.
- G. Manufacturer(s):
1. Phoenix Contact – Quint Series
  2. PULS.
  3. Lambda.
  4. Equal.

## 2.19 DIGITAL PANEL METER

- A. Type:
1. Electronic, 3.5 digit, 0.56 inch high efficiency LED display.
- B. Operation:
1. To accept 4-20 mA DC input signal and provide indication in Engineering Units of measured variable.
- C. Functional:
1. Power supply: 115 VAC, plus or minus 10 percent, 50/60 Hz, 10 VA
  2. Input: 4-20 mA DC into 100 ohms.
  3. Indication: 0.56 inch LED display.
- D. Physical:
1. Case size nominal 2.5 inch high by 5 inch wide by 6 inch deep.
  2. Case type: watertight and dust-tight (NEMA 4X).
  3. Mounting: flush panel suitable for high density mounting arrangements.

- E. Performance: Linear input accuracy plus or minus 0.05 percent of calibrated span, plus or minus 1 count.
- F. Manufacturer(s):
  - 1. Precision Digital.
  - 2. Red Lion.
  - 3. Equal.

## **2.20 MEDIUM OPERATOR INTERFACE TERMINAL**

- A. Description: Medium Operator Interface Terminals shall have viewable screen size of eleven (11) inches. The basis of design is the Schneider Electric Magelis XBT-GT terminal series.
- B. A color STN screen with 4096 solid colors. The screen shall have a 640x480 pixel (VGA) resolution, with a backlighting service life of 50,000 hours of continual usage. There shall be an embedded analog touch sensitive zone with a resolution of 1024x1024. The screen shall have eight (8) levels of brightness, and eight (8) levels of contrast via tactile feedback.
- C. Communication Ports: The Operator Interface Terminals shall have an RJ-45 port, and an integral 9-way male SUB-D connector, dedicated to serial communications shall be provided. The 9-way SUB-D connector shall support RS232/RS485 Communications. The RJ-45 port shall support RS485. Additionally, two (2) type A host USB connectors shall be provided for application downloading and peripheral use. Furthermore, the terminal will be supplied with an integral RJ-45 port dedicated to 10BASE-T/100BASE-TX Ethernet TCP/IP communications. Operator Interface Terminals relying on the same port for communications and downloading shall not be acceptable.
- D. Communication Protocols. The Operator Interface shall be supplied with Modbus or Modbus TCP/IP.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. The panels shall be installed at locations as shown on the Contract Drawings.
- B. Refer to Section 40 50 00.

### **3.02 TESTS**

- A. Refer to Section 40 50 00.

**END OF SECTION**

## **SECTION 40 91 25**

### **MAGNETIC FLOWMETERS**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. This section describes requirements for magnetic flowmeters.

##### **1.2 RELATED WORK**

- A. Section 09 90 00– Painting and Coating
- B. Section 33 01 00 – Piping and Fittings

##### **1.3 REFERENCES**

- A. American Society of Mechanical Engineers (ASME)
- B. American Society for Testing and Materials (ASTM)
- C. American Water Works Association (AWWA)

##### **1.4 SUBMITTALS**

- A. Submittals shall be in accordance with the General Conditions and Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's catalog data and detail drawings showing dimensions, pressure rating, coatings, and meter parts and describe by material of construction specifications (such as AISI, ASTM, SAE, or CDA) and grade or type.

#### **PART 2 PRODUCTS**

##### **2.1 MANUFACTURERS**

- A. Flow meters shall be Siemens Sitrans FM electromagnetic flow meters with MAG 5100 W sensor and MAG 5000 transmitter.

##### **2.2 GENERAL METER DESIGN**

- A. The complete flowmeter shall consist of a flow sensor and an associated transmitter.
- B. Magnetic flowmeter systems shall be of the low frequency electromagnetic induction type and produce a DC pulsed signal directly proportional to and linear with the liquid flow rate. Complete zero stability shall be an inherent characteristic

of the flowmeter system. Each magnetic flow metering system shall include a metering tube, signal cable, transmitter and flowmeter grounding rings.

- C. Sensor and transmitter enclosures shall have NEMA 4X environmental rating.

### 2.3 *SENSOR DESIGN*

- A. Provide stainless steel grounding rings and grounding electrodes per manufacturer's requirements.
- B. Sensor ends shall be ANSI B16.5 or AWWA C-207 flanged connections.

### 2.4 *SENSOR MATERIALS OF CONSTRUCTION*

- A. Housing shall be ASTM A 105 carbon steel with corrosion resistant epoxy coating and flanged connections.
- B. Measuring tube shall be 304 stainless steel with EPDM rubber liner complying with ANSI/NSF Standard 61.
- C. Electrodes shall be Hastelloy C.

### 2.5 *INDICATOR / TRANSMITTER DESIGN*

- A. The microprocessor-based signal converter/transmitter shall be mounted to the sensor or remotely mounted as indicated under "service conditions".
- B. The transmitter shall utilize DC pulse technique to drive flux-producing coils. The DC pulse signal from the tube shall be converted to a standardized 4-20 mA signal into a minimum of 700 ohms.
- C. Max measuring error: +/- 0.4%
- D. Include a 3-line LCD alpha numeric display with backlight for flowrate, percent of span, and totalizer.
- E. Transmitter shall have the following inputs and outputs: 1 digital input, 1 current output, 1 pulse/frequency output, 1 relay output. Transmitter shall support MODBUS communication.
- F. Power supply: 115 – 230 V AC 60 Hz.
- G. Be capable of measuring flow in both directions.

### 2.6 *INTERCONNECTING CABLE*

- A. The interconnecting cable between the sensor and the transmitter shall be furnished by the magnetic flowmeter manufacturer.

## 2.7 SERVICE CONDITIONS

Tag No.	Service	Size (Inches)	Local/Remote Indicator	Flow Range (GPM)
CSA30-BP-FM	Booster pump station flow	8	Local Display with Sun Shield and Remote Indicator	0-2,000
CSA32-BP-FM	Booster pump station flow	8	Local Display with Sun Shield and Remote Indicator	0-2,000

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Magnetic flow meters shall be installed and supported in accordance with the manufacturer's installation instructions.
- B. Meters shall be properly grounded to the adjacent pipe to ensure full pipe grounding.

### 3.2 PAINTING AND COATING

- A. Field coat the exterior of the flow meter sensor housing per Section 09 90 00, System No. 2. Coating color to match adjacent piping.

**END OF SECTION**

## **SECTION 40 91 30**

### **PROCESS PRESSURE AND LEVEL INSTRUMENTS**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. This section describes requirements for pressure gauges; pressure switches, pressure transmitters, and ultrasonic level transmitters.

##### **1.2 RELATED WORK**

- A. Section 26 05 00– Basic Electrical Materials and Methods
- B. Section 26 05 26 – Grounding and Bonding for Electrical Systems
- C. Section 26 05 53 – Electrical Identification
- D. Section 40 50 00 – Instrumentation and Controls General Provisions
- E. Section 40 50 01 – I&C Testing

##### **1.3 REFERENCES**

- A. International Society of Automation (ISE)

##### **1.4 SUBMITTALS**

- A. Submittals shall be in accordance with the General Conditions and Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's catalog data and detail drawings showing dimensions, materials of construction, measurement range, electrical interfaces and protocols, and mounting requirements.

#### **PART 2 PRODUCTS**

##### **2.1 GENERAL**

- A. Unless otherwise noted transmission analog signals shall be 4 mA to 20 mA.
- B. Unless otherwise noted the combined power supply and transmitter loops shall present a voltage signal of 1- to 5-volt DC.
- C. Signal isolators shall be provided where required.
- D. All products shall be UL listed.

**2.2 PRESSURE GAUGES**

- A. Pressure gauges shall be ASME B40.1 Grade 2A bourdon tube type with an accuracy of ½% of full scale. Gauges shall be non-liquid filled unless liquid filled is specifically called out on the drawings.
- B. Dial size shall be 4-1/2” unless otherwise noted on the drawings. Case and ring shall be constructed of fiberglass reinforced thermoplastic. Window shall be glass. Dial shall be aluminum with a white background and black pressure scale. Bourdon tube and movement shall be 300-series stainless steel.
- C. Weather protection of dry cases shall conform to IP54; liquid filled cases shall conform to IP 65.
- D. Process connection size shall be ½ inch NPT.
- E. Liquid filled gauges shall be filled with glycerin.
- F. Pressure switch ranges shall be identified on the drawings directly or by Type Number as listed below.

<b>Type Number</b>	<b>Pressure Range</b>
1	0 – 15 psig
2	0 - 30 psig
3	0 – 60 psig
4	0 – 100 psig
5	0 – 160 psig

- G. Pressure gauges shall be Ashcroft 1259 or equal.

**2.3 PRESSURE SWITCHES**

- A. Pressure switches shall be of the bourdon tube type suitable for operation up to the maximum pressure of the specified operating range.
- B. Both single limit (SPST) and two-limit (SPDT) switches shall utilize non-mercury metal contact snap switches. Switches shall have a calibrated setpoint indicating scale and shall provide indication of on/off position. Separate external adjustment of each operating point shall be possible.
- C. Wetted materials shall be 403 or 316 stainless steel wetted materials. Switch shall be housed inside of a weatherproof enclosure suitable for vertical outdoor uncovered mounting.
- D. Switches shall have a repeatability equal to ± 1.5% of the full operating range. The deadband shall be adjustable over the full-scale.



- E. Process liquid connections shall be ½” male NPT unless otherwise noted on the drawings.
- F. Differential pressure switches shall be as described above and shall have opposing bellows type actuating.
- G. Switches shall be Series DA/DS or DP (for differential pressure) as manufactured by Dwyer Instruments or equal. Each pressure switch shall have capability for low and high pressure switch settings.
- H. Pressure switch ranges shall be identified on the drawings directly or by Type Number as listed below.

Type Number	Pressure Range
1	2 – 60 psig
2	1 – 35 psig
3	5 – 100 psig
4	10 – 200 psig
5	10 – 300 psig

#### 2.4 PRESSURE TRANSMITTERS

- A. Pressure transmitter shall be solid-state polysilicon pressure sensor with 316L isolating diaphragm. Transmitter shall include LCD display for process measurement and diagnostic messages.
- B. Accuracy shall be ±0.075% of calibrated span including the effects of linearity, hysteresis, and repeatability. Total response time shall be 145 milliseconds with a minimum update rate of 20 times per second.
- C. If self-diagnostics detect a sensor failure, the analog signal shall be driven either high or low to alert the user.
- D. Transmitter housing shall be polyurethane painted aluminum with a NEMA 4X rating. Transmitter shall be suitable for outdoor installation with an ambient temperature range of -40 to 170 °F and 0 – 100% relative humidity. LCD shall include integral or accessory protection from direct exposure to sunlight.
- E. Process connection shall be ½-inch NPT female.
- F. Output shall be 4 – 20 mA.
- G. External power source shall be 10.5 – 42.4 Vdc. Provide reverse polarity protection.
- H. Pressure transducer shall be Rosemount (Emerson Process) 2088 or equal.

- I. Pressure switch ranges shall be identified on the drawings directly or by Type Number as listed below:

Type Number	Pressure Range
1	0.6 - 30 psig
2	3 - 150 psig
3	16 – 800 psig

## 2.5 ULTRASONIC LEVEL TRANSMITTERS

- A. Sensor shall be a 2-wire loop-powered ultrasonic transmitter that continuously monitors liquid level in tanks and storage vessels. Unit shall be capable of generating, transmitting, receiving and processing ultrasonic signals and converting those signals into a 4 to 20 mA output proportional to the liquid level.
- B. Unit shall provide continuous level measurement up to 40 feet in range using auto false-echo suppression for fixed obstruction avoidance. Accuracy shall be the greater of  $\pm 0.15\%$  of range or 0.24 inches. Beam angle shall be ten degrees.
- C. Power supply shall be nominal 24V DC, 30 V DC maximum with 550 ohm maximum.
- D. Unit shall incorporate internal temperature sensor to compensate for temperature changes. Update time shall be less than five seconds.
- E. Unit shall incorporate a local LCD display with bar graph.
- F. Unit, including local LCD display, shall be suitable for uncovered outdoor installation with an ambient temperature range of -40 to 170 °F and 0 – 100% relative humidity. Enclosure shall be constructed of polybutylene terephthalate and provide NEMA 4X protection. Transducer shall be constructed of PVDF.
- G. Process connection shall be 2" NPT.
- H. Unit shall be programmed using an infrared handheld programmer. Furnish one handheld programmer for use on all ultrasonic level transmitters furnished on the project.
- I. Unit shall be Siemens SITRANS Probe LU or equal

## PART 3 EXECUTION

- A. Instruments shall be installed in easily accessible locations and oriented for ease of reading and maintenance.

- B. All instrumentation shall be calibrated and tested after installation. The Contractor shall provide all necessary labor, tools, and equipment to calibrate and test each instrument in accordance with the manufacturer's instructions. Each instrument shall be calibrated at a minimum of three points using test equipment to simulate inputs and read outputs. All test equipment and all instruments used to simulate inputs and read outputs shall be suitable for the purpose intended and shall have an accuracy better than the required accuracy of the instrument being calibrated. Test equipment shall have accuracies traceable to the NIST as applicable.
- C. Instruments shall be prepared for use in accordance with manufacturer's instructions after field calibration.
- D. All instruments of a given type shall be supplied the same manufacturer.

**END OF SECTION**

## SECTION 40 96 31

### SCADA CONTROL LOOP DESCRIPTIONS

#### PART 1 GENERAL

##### 1.1 SECTION DESCRIPTION

- A. This section, in conjunction with specific requirements contained in the P&ID drawings, plans and specifications, describes the function of the project controls and instrumentation. The contractor is responsible for providing a finished supervisory control and data acquisition system and associated programming that can accomplish all of the following functions and provides the necessary operator interface to monitor the process, control the process, generate reports, and adjust setpoints as necessary. The system will be based on remote terminal units (RTUs) and human machine interfaces (HMIs) at each project site all communicating with the County's SCADA system. The Process Control System Supplier (PCSS) will be responsible for:
1. Integrating all new backwash and chemical feed pump controls and instrumentation into the RTUs at all project sites;
  2. Providing the site-specific hard-wired interlock features described in this specification;
  3. Programming the County's SCADA system to interface with the new I/O from the site RTUs including providing alarm and reporting functionality.
- B. The control functions described in this section are in addition to any control functions described elsewhere on the plans or specifications.
- C. All analog instruments shall include the following operator adjustable alarms:
1. Instrument fail
  2. High-high
  3. High
  4. Low
  5. Low-low
- D. All software and hard-wired control functions shall include adjustable timer delays.

##### 1.2 RELATED WORK

- A. Section 46 33 43 – Motor Operated Diaphragm Chemical Feed Pump

- B. Section 46 33 85 – Chemical Metering Skids and Accessories
- C. All Division 40 instrumentation and controls related specifications

## **PART 2 CONTROL LOOP DESCRIPTIONS**

### *2.1 CSA 30 CONTROL LOOP DESCRIPTION*

#### A. Miscellaneous Well Functions

1. References in these control loop descriptions to “Well No. #” or “well #” shall mean the specific well referenced, and all associated subsystems. References to “Well Facility” shall mean both wells, the storage tank and the booster pump station in total.
2. The Well facility shall be capable of being operated in two modes:
  - a. Tank supplied from Well No. 1 only.
  - b. Tank supplied from Well No. 2 only.
3. Under no circumstances shall both wells operate simultaneously.
4. In either mode, the high service pumping station shall pump water from the tank into the distribution system.
5. Well start-up and shutdown: Provide a hand-off-automatic loop at the master control system. Furthermore, provide a selector switch to toggle between Well No. 1 and Well No. 2.
  - a. In hand mode, the Well selected via the toggle switch per Paragraph 2.1.A.5 shall start provided that startup is not inhibited by a high-high water storage tank level.
  - b. In off mode, both wells shall be off.
  - c. In automatic mode, the selected well shall be called on based on a low water storage tank level and shall shut off based on a high water storage tank level as measured by LIT-3001. After shut off, the system shall automatically switch the selected well so that the wells alternate operation.

#### B. Well No. 1

1. The tank level indicator LIT-3001 measurement shall be available at the SCADA workstation
2. The well flow meter FIT 3000 measurement shall be available at the SCADA workstation

3. The well pump prelube solenoid shall open when the well is called on and shall remain open for a programmable time after the well motor has started. The well motor shall be inhibited for a period of time after the prelube solenoid has been opened.
4. The well shall shut off should the existing high or low water level switch be activated following an adjustable time delay.
5. The well pump shall operate in one mode: Across the Line (constant speed) operation.

C. Well No. 2

1. The tank level indicator LIT-3001 measurement shall be available at the SCADA workstation
2. The well flow meter FIT 3001 measurement shall be available at the SCADA workstation
3. The well pump prelube solenoid shall open when the well is called on and shall remain open for a programmable time after the well motor has started. The well motor shall be inhibited for a period of time after the prelube solenoid has been opened.
4. The well shall shut off should the existing high or low water level switch be activated following an adjustable time delay.
5. The well pump shall operate in one mode: Across the Line (constant speed) operation.

D. Hydropneumatic Tank

1. The SCADA system shall monitor the hydropneumatic tank air compressor run/alarm status and display this information at the SCADA workstation.

E. Water Storage Tank

1. Water storage tank level shall be monitored by existing water level switch.
2. The tank level LIT-3001 measurement shall be available at the SCADA system.

F. High Service Pumping Station

1. BSTR-DP-1 and BSTR-30-DP-2 shall alternate in a lead/lag fashion based on pump starts.
2. Pumps shall operate based on Operator selectable pressures as measured at pressure transducer PIT 3001. These pressure setpoints shall initially be:

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- a. Lead Pump Call: 44 psi
- b. Lead Pump Off: 64 psi
- c. Lag Pump Call: 40 psi
- d. Lag Pump Off: 60 psi
- e. High Flow Pump Call: 35 psi
- f. High Flow Pump Off: 55 psi

G. CSA 30 Manganese Treatment Plant

- 1. All I/O and associated SCADA functionality at the existing CSA 30 Well 1 and Well 2 sites and the CSA treatment site shall be maintained.
- 2. A power outage at the CSA 30 treatment plant shall result in an alarm at SCADA.
- 3. Treatment Vessels
  - a. During normal operation, an alarm shall be generated based on the flow rate as measured at XX-FE/FIT-XX for Well 1 or XX-FE/FIT-XX for Well 2. The flow alarms will be operator-selectable with the following initial setpoints:
    - 1) High: 80 gpm.
    - 2) Low: 20 gpm.
  - b. Backwash flow rate through the treatment system shall be monitored using vessel flow meter 3003-FE/FIT.
  - c. Backwash flow rate shall be available at the SCADA system.
- 4. Chemical Feed System
  - a. The sodium hypochlorite metering pump 30-CMP-01 at the CSA 30 treatment site shall be interlocked to run based on run signal from CSA 30 Well 1 and Well 2. The signal shall identify which well of the CSA 30 Well 1 and Well 2 is active. The signal shall be transmitted via SCADA.
  - b. The sodium hypochlorite metering pump 30-CMP-01 shall be flow paced to maintain the same dose under varying flow from CSA 30

Well 1 and Well 2 as measured by the CSA 30 Well 1 and Well 2 flow meters.

- c. The run status and pump fail signals from the sodium hypochlorite metering pump shall be monitored at SCADA.
- d. A fail signal from the chemical metering pump shall result in an operator alarm.

5. Water Quality Analyzers

- a. All water quality instrument measurements (chlorine residual analyzer and pH probe) shall be continuously transmitted to SCADA.
- b. Chlorine residual level shall be measured by chlorine residual analyzer 30-AE/AIT-01.
  - 1) High level alarm shall be generated if the chlorine residual level exceeds an operator-selectable set point initially set to 1.5 mg/L.
  - 2) Low level alarm shall be generated if the chlorine residual level is less than an operator-selectable set point initially set to 0.6 mg/L.

2.2 CSA 32 CONTROL LOOP DESCRIPTION

A. Miscellaneous Well Functions

- 1. References in these control loop descriptions to “Well No. #” or “well #” shall mean the specific well referenced, and all associated subsystems. References to “Well Facility” shall mean both wells, the storage tank and the booster pump station in total.
- 2. The Well facility shall be capable of being operated in two modes:
  - a. Tank supplied from Well No. 1 only.
  - b. Tank supplied from Well No. 2 only.
- 3. Under no circumstances shall both wells operate simultaneously.
- 4. In either mode, the high service pumping station shall pump water from the tank into the distribution system.
- 5. Well start-up and shutdown: Provide a hand-off-automatic loop at the master control system. Furthermore, provide a selector switch to toggle between Well No. 1 and Well No. 2.



- a. In hand mode, the Well selected via the toggle switch per Paragraph 2.2.A.5 shall start provided that startup is not inhibited by a high-high water storage tank level.
- b. In off mode, both wells shall be off.
- c. In automatic mode, the selected well shall be called on based on a low water storage tank level and shall shut off based on a high water storage tank level as measured by LIT-32. After shut off, the system shall automatically switch the selected well so that the wells alternate operation.

B. Well No. 1

1. The tank level indicator LIT-32 measurement shall be available at the SCADA workstation
2. The well flow meter FIT 3200 measurement shall be available at the SCADA workstation
3. The well pump prelube solenoid shall open when the well is called on and shall remain open for a programmable time after the well motor has started. The well motor shall be inhibited for a period of time after the prelube solenoid has been opened.
4. The well shall shut off should the existing high or low water level switch be activated following an adjustable time delay.
5. The well pump shall operate in one mode: Across the Line (constant speed) operation.

C. Well No. 2

1. The tank level indicator LIT-32 measurement shall be available at the SCADA workstation
2. The well flow meter FIT 3201 measurement shall be available at the SCADA workstation
3. The well pump prelube solenoid shall open when the well is called on and shall remain open for a programmable time after the well motor has started. The well motor shall be inhibited for a period of time after the prelube solenoid has been opened.
4. The well shall shut off should the existing high or low water level switch be activated following an adjustable time delay.
5. The well pump shall operate in one mode: Across the Line (constant speed) operation.

- D.    Hydropneumatic Tank
  - 1.     The SCADA system shall monitor the hydropneumatic tank air compressor run/alarm status and display this information at the SCADA workstation.
  
- E.    Water Storage Tank
  - 1.     Water storage tank level shall be monitored by existing water level switch.
  
- F.    High Service Pumping Station
  - 1.     For pumps BSTR-DP-1, and BSTR-DP-2, which have the same capacity, the lead pump shall be cycled through the available pumps each time a pump of this capacity is called on.
  - 2.     BSTR-DP-1 and BSTR-DP-2 shall alternate in a lead lag fashion.
    - a.     Lead Pump Call: 42 psi
    - b.     Lead Pump Off: 62 psi
    - c.     Lag Pump Call: 38 psi
    - d.     Lag Pump Off: 62 psi
    - e.     High Flow Pump Call: 35 psi
    - f.     High Flow Pump Off: 62 psi
  
- G.    CSA 32 Manganese Treatment Plant
  - 1.     All I/O and associated SCADA functionality at the existing CSA 32 Well 1 and Well 2 sites and the CSA treatment site shall be maintained.
  - 2.     A power outage at the CSA 32 treatment plant shall result in an alarm at SCADA.
  - 3.     Treatment Vessels
    - a.     Backwash flow rate through the individual treatment system shall be monitored by SCADA using vessel flow meter 32003-FE/FIT.
    - b.     During normal operation, a high level alarm shall be generated if the flow rate exceeds an operator-selectable flow rate initially set to 80 gpm.
  - 4.     Chemical Feed System
    - a.     The sodium hypochlorite metering pump 32-CMP-01 at the CSA 32 treatment site shall be interlocked to run based on run signal from

CSA 32 Well 1 and Well 2. The signal shall identify which well of the CSA 32 Well 1 and Well 2 is active. The signal shall be transmitted via SCADA.

- b. The sodium hypochlorite metering pump 32-CMP-01 shall be flow paced to maintain the same dose under varying flow from CSA 32 Well 1 and Well 2 as measured by the CSA 32 Well 1 and Well 2 flow meters.
  - c. The run status, revolution counter, and pump fail signals from the sodium hypochlorite metering pump shall be monitored at SCADA.
  - d. A fail signal from the chemical metering pump shall result in an operator alarm.
5. Water Quality Analyzers
- a. All water quality instrument measurements (chlorine residual analyzer and pH probe) shall be continuously transmitted to SCADA.
  - b. Chlorine residual level shall be measured by chlorine residual analyzer 32-AE/AIT-01.
    - 1) High level alarm shall be generated if the chlorine residual level exceeds an operator-selectable set point initially set to 1.5 mg/L.
    - 2) Low level alarm shall be generated if the chlorine residual level is less than an operator-selectable set point initially set to 0.2 mg/L.

**END OF SECTION**

## **SECTION 43 21 14**

### **VERTICAL INLINE CENTRIFUGAL PUMPS**

#### **PART 1 GENERAL**

##### *1.1 WORK INCLUDED*

This section includes vertical inline centrifugal pumps complete with pump, motor, and mounting base for potable water service. The Contractor shall provide all items, and operations, including all labor, materials, equipment, and incidentals necessary for completion of work.

##### *1.2 RELATED WORK*

- A. Section 09 90 00 – Painting and Coating (Site Work)
- B. Section 33 13 00 – Disinfection of Water System
- C. Section 40 05 00 – Pipe & Fittings
- D. Section 40 05 23 – Valves and Appurtenances

##### *1.3 REFERENCES*

- A. American Water Works Association (AWWA)
- B. Hydraulic Institute (HI)
- C. American Society for Testing and Materials (ASTM)
- D. American National Standards Institute (ASNSI)
- E. National Electrical Manufacturers Association (NEMA)

##### *1.4 SUBMITTALS*

- A. Submit shop drawings in accordance with General Provisions.
- A. As specified in Section 01 33 00 – Submittal Procedures
- C. Submit dimensional drawings.
- D. Submit manufacturer's catalog data and detail drawings showing all pump parts and described by material of construction, specification (such as AISI, ASTM, etc.), and grade or type. Show linings and coatings. Include total pump weight.
- E. Submit pump manufacturer ISO-9001 certification.

- F. Submit catalog pump curves on which the specified operating points are marked. Show efficiency and brake horsepower for the selected pump curve. Show required NPSH.
- G. Submit manufacturer's sample form for reporting performance test results at least two weeks before the tests. The test form should contain the data presented in the sample form in Section 6 of the ASME PTC 8.2.
- H. Submit manufacturer's certified performance curves for review at least two weeks prior to shipping the units from the factory. Show pump total head, brake horsepower, pump efficiency, and required NPSH. Provide copies of the data recorded during the test and methods of data reduction for determining certified test results.
- I. Submit motor data.
- J. Submit manufacturer's installation instructions, including anchorage requirements.
- K. Submit Operations and Maintenance Manual

#### 1.5 *QUALITY ASSURANCE*

- A. All components must be supplied by the pump manufacturer as an integrated and compatible system. The pump manufacturer shall have complete unit responsibility for meeting the requirements of this specification.
- B. Pump manufacturer shall have ISO-9001 certification. As an alternative, provide a letter from the pump manufacturer accepting warranty responsibility for the entire pump, motor, and baseplate unit.
- C. Except as modified or supplemented herein, all pumps shall conform to the applicable requirements of all ANSI-Hydraulic Institute Standards.
- D. All materials and coatings in contact with potable water shall be ANSI/NSF-61 certified.
- E. All materials of construction shall comply with California "Lead Free" regulations.

## **PART 2 PRODUCTS**

### 2.1 *MANUFACTURERS*

- A. Pumps and appurtenances shall be manufactured by Xylem (Goulds), Pentair (Aurora), Grundfos (PACO), Peerless, Pentair, or equal.

### 2.2 *DESIGN REQUIREMENTS*

- A. The pump curve shall be continuously rising and free from dips and valleys from 70 percent of the design flow to the shutoff head.

- B. For design and rating purposes, the temperature of the water to be pumped is anticipated to range between 64 and 78 degrees Fahrenheit.
- C. Pump performance shall be stable and free from damaging cavitation, vibration, and noise within the operating range.
- D. The pump and motor shall each be supported on a common base.
- E. Where secondary pump hydraulic design conditions are provided below and the pump to be supplied deviates from any of the secondary head values by more than 10% of the primary design head value, the supplier shall obtain approval from the Engineer for the pump prior to bidding the project. The Engineer’s approval, if obtained, shall constitute approval of the general shape of the pump curve and shall not relieve the Supplier from any other requirements contained in this specification.
- F. Contractor shall design pump anchorage according to site specific criteria.

2.3 SERVICE CONDITIONS

A. Booster Pumps (Duty Pumps)

Service	CSA 30		CSA 32	
	Duty Pumps		Duty Pumps	
Tag Numbers	BSTR-DP-1	BSTR-DP-2	BSTR-DP-1	BSTR-DP-2
Location	Outdoors	Outdoors	Outdoors	Outdoors
Elevation (ft)	416	416	300	300
Design Flow (GPM)	122	122	257	257
Design TDH (ft)	133	133	95	95
Maximum RPM at Design Condition	3,500	3,500	1,750	1,750
Minimum Efficiency at Design	73.6%	73.6%	75.9%	75.9%

<b>Flow/TDH</b>				
<b>Maximum Motor HP</b>	10	10	10	10
<b>Variable Speed</b>	No	No	No	No
<b>Minimum NPSHA (ft)</b>	36	36	33	33

<b>Secondary Conditions Defining General Curve Shape</b>			
<b>CSA 30</b>		<b>CSA 32</b>	
<b>Flow</b>	<b>Total Head</b>	<b>Flow</b>	<b>Total Head</b>
96	148	100	139
119	133	257	95
192	85	312	70

**2.4 MATERIALS OF CONSTRUCTION**

A. Materials of construction shall be as follows:

<b>Component</b>	<b>Material</b>	
	<b>CSA 30</b>	<b>CSA 32</b>
Casing	Cast Iron (A48)	Cast Iron (A48)
Impeller	Stainless Steel (A193 - 316)	Stainless Steel (A193 - 316)
Shaft	Duplex Stainless Steel (A182-F51)	Duplex Stainless Steel (A182-F51)
Shaft Sleeves	Stainless Steel (A193-316)	Stainless Steel (A193-316)
Bearings	Regreaseable ball bearings	Regreaseable ball bearings

Bolting	Stainless Steel (304 or 316)	Stainless Steel (304 or 316)
Case Wear Rings	PPS	PPS

2.5 *CASING*

- A. The casing shall be double volute on 4-inch and larger discharges to reduce bearing loads.
- B. Suction and discharge connections shall be flat face flanged (125-lb ANSI 21.10, AWWA C110 and ANSI B16.1)
- C. The casing shall have tapped and plugged holes for pressure gauges on the suction and discharge.
- D. The casing shall be equipped with feet for easy back pullout without disturbing the suction and discharge piping connections.
- E. The lower half of the casing shall be furnished with cored passageways from the high pressure area of the volute to each seal box for positive lubrication without the use of external flushing lines. The bearing arms shall be cast integrally with the lower half of the casing to assure positive bearing alignment.
- F. Provide lifting eye bolts or lugs.

2.6 *IMPELLER*

- A. The impellers shall be of the single suction enclosed type and cast in one piece.
- B. The impellers shall be dynamically balanced.
- C. The pump impellers shall be secured to the shaft by a split cone and nut.

2.7 *SHAFT*

- A. The pump shaft shall be one-piece, finished, and polished along its entire length.
- B. The maximum allowable deflection of the shaft shall be 0.002 inches at any point of operation on the pump curve.
- C. The shaft shall include a shaft sleeve slip fit over the shaft, keylocked, and extending the full length of the seal box.
- D. The shaft journal and chamber bearings shall be Tungsten Carbide and Bronze

2.8 *BEARINGS*

- A. Bearings shall be regreaseable lubricated ball bearings.



- B. Bearings shall have a minimum L-10 bearing life of 50,000 hours at continuous maximum load and speed

## 2.9 CASE WEAR RING

- A. The pump casing shall be fitted with a front case wear ring to minimize abrasive and corrosive wear to the casing. The wear ring shall be of the radial type, shall have a shoulder machined around the circumference to match a machined shoulder in the casing to provide two sealing faces and to locate the ring in the casing.
- B. The ring shall be securely restrained from rotation by means of pins to the lower casing half.

## 2.10 SEAL

- A. Pump shall be equipped with a mechanical seal.
- B. Mechanical seal shall be constructed with all metal parts to be 303 stainless steel, Buna-N elastomers, ceramic seat, and carbon washer.
- C. The mechanical seal box shall be equipped with a heavy, cast, one piece O-ring sealed gland.

## 2.11 COUPLING

- A. A flexible coupling shall be provided to connect the pump shaft to the motor shaft.
- B. The coupling shall be of an all metal type with a flexible rubber insert.
- C. The entire rotating element shall be enclosed by a Cal/OSHA approved galvanized steel or stainless steel coupling guard.

## 2.12 BASE

- A. The pump and motor shall be mounted on a common heavy, groutable steel or cast iron baseplate with integral drip channels incorporated on each side.
- B. The base shall be sufficiently rigid to support the pump and motor without the use of additional supports or members. The minimum base plate stiffness shall conform to ANSI/HI 1.3.4 for Horizontal Baseplate Design standards.

## 2.13 MOTOR

- A. Electric motors shall be NEMA Design B, squirrel-cage induction motors designed for normal starting torque with low starting current. In no case shall starting torque or breakdown torque be less than the value indicated in ANSI/NEMA MG 1.
- B. Motors shall be fabricated, assembled, and tested in accordance with the most current applicable standards as defined by ANSI, IEEE, NEMA, and AFBMA. Motors

- shall comply with ANSI/NEMA MG 1. Motors shall be labeled as being approved by the Underwriters Laboratories (UL).
- C. Motor Voltage Ratings: Motors shall be rated in accordance with the following unless indicated otherwise on the drawings:
1. Motors below ½ HP shall be rated 115 volts, single phase, 60-Hz. Dual voltage motors rated 115/230 volts, 115/208 volts, or 120-240 volts are acceptable.
  2. Motors ½ HP and larger shall be rated 460 volts, 3-phase, 60 Hz. Dual voltage motors rated 230/460 volts or 208/230/460 volts are acceptable.
- D. Each motor shall have sufficient horsepower rating to operate the pump at any point on the pump's head-capacity curve without overloading the nameplate horsepower rating of the motor. Motors shall have a service factor of at least 1.15.
- E. Motors smaller than 50 HP installed outdoors shall be totally enclosed, fan cooled (TEFC). Motors larger than 50 HP which will be installed outdoors shall be Weather Protected Type II. Motors which will be installed indoors shall be open drip-proof with 2 cycles of solid baked epoxy vacuum impregnation or Weather Protected Type I or II.
- F. Motors shall include Class F insulation, rated to operate at an ambient temperature of 40 degrees C without exceeding Class B temperature rise limits at the motors nominal rating.
- G. Inverter duty motors shall be equipped with shaft-grounding with stub shaft extended from the motor shaft. Grounding unit shall be equipped with two brushes, totally enclosed and sealed against environmental contamination.
- H. Six 100-ohm platinum resistance temperature detectors (RTDs) shall be provided in the stator windings for constant speed motors 250 HP and larger and inverter duty motors 100 HP and larger; and one PTC thermister shall be provided on the stator windings for motors from 60 to 250 HP.
- I. 120 volt space heaters shall be provided on all 25 HP and larger motors.
- J. Motors shall include bearings with a minimum L-10 life of 50,000 hours. Motors larger than 2 HP shall include relubricatable ball bearings.
- K. Motors over 25 HP shall have short commercial tests performed which include: no load current, locked rotor current, winding resistance, high potential, and vibration and bearing inspection.

## 2.14 FACTORY COATING

- A. Coat pump, frame, and motor per Specification 099000, System 2.

## 2.15 *FACTORY PERFORMANCE TESTING*

- A. Each pump shall be non-witness tested at the factory for capacity, power requirement, and efficiency at minimum head, rated head, shutoff head or point of discontinuity, and at as many other points as necessary for accurate performance curve plotting. All tests and test reports shall conform to the requirements and recommendations of the Hydraulic Institute Standards. If the pump fails to operate properly or fails to meet the specified conditions or requirements during shop testing, the pump manufacturer shall modify the pumping unit and perform additional tests. The pump manufacturer shall submit complete pump test reports, including test arrangement, instrumentation calibration data, test procedures, & test data in curve format.
- B. Each pump shall be subjected to a non-witnessed factory hydrostatic test per ANSI/HI 1.6.

## **PART 3 EXECUTION**

### 3.1 *SHIPMENT*

- A. All equipment shall include a stainless steel nameplate including the equipment tag number.
- B. The interior of the equipment shall be clean and free from debris.
- C. Provide and label lifting points for all pump components.

### 3.2 *INSTALLATION*

- A. Provide all manufacturer recommended lubricants for the pump and motor.
- B. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation, and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of ENGINEER.
- C. Install the pump per ANSI/HI 1.4. Ensure that pump flanges are properly aligned prior to installing bolts. Do not allow any piping strain to be transmitted to the pump.
- D. The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.
- E. All costs of these services shall be included in the contract price for the number of days and round trips to the site as required.

### 3.3 *FIELD QUALITY CONTROL*

- A. Bump motor to ensure proper rotational direction.
- B. Perform field vibration measurements during normal operation. Vibration levels shall be within HI limits. Repair or replace pumps not meeting the HI vibration limits.
- C. Collect flow and discharge pressure data from at least three different flow rates, including the design flow rate. Compare the data with the factory performance curve and notify the Engineer if the data varies by more than 5%.

**END OF SECTION**

## **SECTION 43 21 15**

### **HORIZONTAL END SUCTION CENTRIFUGAL PUMPS**

#### **PART 1 GENERAL**

##### *1.1 WORK INCLUDED*

- A. This section includes materials, testing, and installation of frame-mounted, flexible coupled, horizontal end suction pumps for the water distribution system.

##### *1.2 RELATED WORK*

- A. Section 09 90 00 – Painting and Coating (Site Work)
- B. Section 33 13 00 – Disinfection of Water System
- C. Section 40 05 00 – Pipe & Fittings

##### *1.3 REFERENCES*

- A. American Water Works Association (AWWA)
- B. Hydraulic Institute (HI)
- C. American Society for Testing and Materials (ASTM)
- D. American National Standards Institute (ASNSI)
- E. National Electrical Manufacturers Association (NEMA)

##### *1.4 SUBMITTALS*

- A. Submit shop drawings in accordance with General Provisions.
- B. As specified in Section 01 33 00 – Submittal Procedures
- C. Submit dimensional drawings.
- D. Submit manufacturer's catalog data and detail drawings showing all pump parts and described by material of construction, specification (such as AISI, ASTM, etc.), and grade or type. Show linings and coatings. Include total pump weight.
- E. Submit pump manufacturer ISO-9001 certification.
- F. Submit catalog pump curves on which the specified operating points are marked. Show efficiency and brake horsepower for the selected pump curve. Show required NPSH.

- G. Submit manufacturer's sample form for reporting performance test results at least two weeks before the tests. The test form should contain the data presented in the sample form in Section 6 of the ASME PTC 8.2.
- H. Submit manufacturer's certified performance curves for review at least two weeks prior to shipping the units from the factory. Show pump total head, brake horsepower, pump efficiency, and required NPSH. Provide copies of the data recorded during the test and methods of data reduction for determining certified test results.
- I. Submit motor data.
- J. Submit manufacturer's installation instructions, including anchorage requirements.
- K. Submit Operations and Maintenance Manual

### 1.5 *QUALITY ASSURANCE*

- A. All components must be supplied by the pump manufacturer as an integrated and compatible system. The pump manufacturer shall have complete unit responsibility for meeting the requirements of this specification.
- B. Pump manufacturer shall have ISO-9001 certification. As an alternative, provide a letter from the pump manufacturer accepting warranty responsibility for the entire pump, motor, and baseplate unit.
- C. Except as modified or supplemented herein, all pumps shall conform to the applicable requirements of all ANSI-Hydraulic Institute Standards.
- D. All materials and coatings in contact with potable water shall be ANSI/NSF-61 certified.
- E. All materials of construction shall comply with California "Lead Free" regulations.

## **PART 2 PRODUCTS**

### 2.1 *MANUFACTURERS*

- A. Pumps and appurtenances shall be manufactured by Pentair (Aurora), Grundfos (PACO), ITT (Goulds), Peerless, or equal.

### 2.2 *DESIGN REQUIREMENTS*

- A. The pump curve shall be continuously rising and free from dips and valleys from 70 percent of the design flow to the shutoff head.
- B. For design and rating purposes, the temperature of the water to be pumped is anticipated to range between 64 and 78 degrees Fahrenheit.

- C. Pump performance shall be stable and free from damaging cavitation, vibration, and noise within the operating range.
- D. The pump and motor shall each be supported on a common base.
- E. Where secondary pump hydraulic design conditions are provided below and the pump to be supplied deviates from any of the secondary head values by more than 10% of the primary design head value, the supplier shall obtain approval from the Engineer for the pump prior to bidding the project. The Engineer’s approval, if obtained, shall constitute approval of the general shape of the pump curve and shall not relieve the Supplier from any other requirements contained in this specification.
- F. Contractor shall design pump anchorage according to site specific criteria.

**2.3 SERVICE CONDITIONS**

- A. Booster Pumps (Duty Pumps) and High Flow Pumps

Service	CSA 30	CSA 32
	High Flow	High Flow
<b>Tag Numbers</b>	BSTR-HF-1	BSTR-HF-1
<b>Location</b>	Outdoors	Outdoors
<b>Elevation</b>	416	300 ft
<b>Design Flow (GPM)</b>	1,074	1,169
<b>Design TDH (ft)</b>	86	128
<b>Maximum RPM at Design Condition</b>	1,800	1,800
<b>Minimum Efficiency at Design Flow/TDH</b>	74.4%	76.5%
<b>Maximum</b>	40	60

<b>Motor HP</b>		
<b>Variable Speed</b>	No	No
<b>Minimum NPSHA</b>	27.3	25.3

<b>Secondary Conditions Defining General Curve Shape</b>			
<b>CSA 30</b>		<b>CSA 32</b>	
<b>Flow</b>	<b>Total Head</b>	<b>Flow</b>	<b>Total Head</b>
240	139	1,080	139
1,089	88	1,169	128
1,220	60	1,460	57

**2.4 MATERIALS OF CONSTRUCTION**

A. Materials of construction shall be as follows:

<b>Component</b>	<b>CSA 30</b>	<b>CSA 32</b>
	<b>Material</b>	<b>Material</b>
Casing	Gray Iron (ASTM A48)	Gray Iron (ASTM A48)
Impeller	Silicon Bronze (ASTM 584)	Silicon Bronze (ASTM 584)
Shaft	Carbon Steel (AISI C1045) or stainless steel	Carbon Steel (AISI C1045) or stainless steel
Shaft Sleeves	Stainless Steel (AISI 316)	Stainless Steel (AISI 316)
Bearings	Regreaseable ball bearings	Regreaseable ball bearings
Bolting	Stainless Steel (304 or 316)	Stainless Steel (304 or 316)



Case Wear Rings	Bismuth Brass	Bismuth Brass
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## 2.5 CASING

- A. The casing shall be double volute on 4-inch and larger discharges to reduce bearing loads.
- B. Suction and discharge connections shall be flat face flanged (125-lb ANSI 21.10, AWWA C110 and ANSI B16.1)
- C. The casing shall have tapped and plugged holes for pressure gauges on the suction and discharge.
- D. The casing shall be equipped with feet for easy back pullout without disturbing the suction and discharge piping connections.
- E. The lower half of the casing shall be furnished with cored passageways from the high pressure area of the volute to each seal box for positive lubrication without the use of external flushing lines. The bearing arms shall be cast integrally with the lower half of the casing to assure positive bearing alignment.
- F. Provide lifting eye bolts or lugs.

## 2.6 IMPELLER

- A. The impeller shall be of the single suction enclosed type and cast in one piece.
- B. The impeller shall be dynamically balanced.

## 2.7 SHAFT

- A. The pump shaft shall be one-piece, finished, and polished along its entire length.
- B. The maximum allowable deflection of the shaft shall be 0.002 inches at any point of operation on the pump curve.
- C. The shaft shall include a shaft sleeve slip fit over the shaft, keylocked, and extending the full length of the seal box.

## 2.8 BEARINGS

- A. Bearings shall be regreaseable lubricated ball bearings.
- B. Bearings shall have a minimum L-10 bearing life of 50,000 hours at continuous maximum load and speed

## 2.9 CASE WEAR RING

- A. The pump casing shall be fitted with a front case wear ring to minimize abrasive and corrosive wear to the casing. The wear ring shall be of the radial type, shall

have a shoulder machined around the circumference to match a machined shoulder in the casing to provide two sealing faces and to locate the ring in the casing.

- B. The ring shall be securely restrained from rotation by means of pins to the lower casing half.

#### 2.10 SEAL

- A. Pump shall be equipped with a mechanical seal.
- B. Mechanical seal shall be constructed with all metal parts to be 303 stainless steel, Buna-N elastomers, ceramic seat, and carbon washer.
- C. The mechanical seal box shall be equipped with a heavy, cast, one piece O-ring sealed gland.

#### 2.11 COUPLING

- A. A flexible coupling shall be provided to connect the pump shaft to the motor shaft.
- B. The coupling shall be of an all metal type with a flexible rubber insert.
- C. The entire rotating element shall be enclosed by a Cal/OSHA approved galvanized steel or stainless steel coupling guard.

#### 2.12 BASE

- A. The pump and motor shall be mounted on a common heavy, groutable steel or cast iron baseplate with integral drip channels incorporated on each side.
- B. The base shall be sufficiently rigid to support the pump and motor without the use of additional supports or members. The minimum base plate stiffness shall conform to ANSI/HI 1.3.4 for Horizontal Baseplate Design standards.

#### 2.13 MOTOR

- A. Electric motors shall be NEMA Design B, squirrel-cage induction motors designed for normal starting torque with low starting current. In no case shall starting torque or breakdown torque be less than the value indicated in ANSI/NEMA MG 1.
- B. Motors shall be fabricated, assembled, and tested in accordance with the most current applicable standards as defined by ANSI, IEEE, NEMA, and AFBMA. Motors shall comply with ANSI/NEMA MG 1. Motors shall be labeled as being approved by the Underwriters Laboratories (UL).
- C. Motor Voltage Ratings: Motors shall be rated in accordance with the following unless indicated otherwise on the drawings:

1. Motors below ½ HP shall be rated 115 volts, single phase, 60-Hz. Dual voltage motors rated 115/230 volts, 115/208 volts, or 120-240 volts are acceptable.
  2. Motors ½ HP and larger shall be rated 460 volts, 3-phase, 60 Hz. Dual voltage motors rated 230/460 volts or 208/230/460 volts are acceptable.
- D. Each motor shall have sufficient horsepower rating to operate the pump at any point on the pump's head-capacity curve without overloading the nameplate horsepower rating of the motor. Motors shall have a service factor of at least 1.15.
- E. Motors smaller than 50 HP installed outdoors shall be totally enclosed, fan cooled (TEFC). Motors larger than 50 HP which will be installed outdoors shall be Weather Protected Type II. Motors which will be installed indoors shall be open drip-proof with 2 cycles of solid baked epoxy vacuum impregnation or Weather Protected Type I or II.
- F. Motors shall include Class F insulation, rated to operate at an ambient temperature of 40 degrees C without exceeding Class B temperature rise limits at the motors nominal rating.
- G. Motors for variable frequency drives (VFD) shall be specifically rated for inverter duty and shall be severe duty NEMA MG 1 design A or B, high efficiency, with NEMA MG 1 Class F insulation. Winding temperature rise shall be limited to Class B rise when operating over the specified speed range. Motor insulation shall be designed to meet NEMA MG 1, Part 31 (1600-volt peak at a minimum of 0.1 microsecond rise time). Motors shall conform to IEEE 841. All internal surfaces shall be coated with epoxy paint.
- H. Inverter duty motors shall be equipped with shaft-grounding with stub shaft extended from the motor shaft. Grounding unit shall be equipped with two brushes, totally enclosed and sealed against environmental contamination.
- I. Six 100-ohm platinum resistance temperature detectors (RTDs) shall be provided in the stator windings for constant speed motors 250 HP and larger and inverter duty motors 100 HP and larger; and one PTC thermister shall be provided on the stator windings for motors from 60 to 250 HP.
- J. 120 volt space heaters shall be provided on all 25 HP and larger motors.
- K. Motors shall include bearings with a minimum L-10 life of 50,000 hours. Motors larger than 2 HP shall include relubricatable ball bearings.
- L. Motors over 25 HP shall have short commercial tests performed which include: no load current, locked rotor current, winding resistance, high potential, and vibration and bearing inspection.

## 2.14 FACTORY COATING

- A. Coat pump, frame, and motor per Specification 099000, System 2.

## 2.15 FACTORY PERFORMANCE TESTING

- A. Each pump shall be non-witness tested at the factory for capacity, power requirement, and efficiency at minimum head, rated head, shutoff head or point of discontinuity, and at as many other points as necessary for accurate performance curve plotting. All tests and test reports shall conform to the requirements and recommendations of the Hydraulic Institute Standards. If the pump fails to operate properly or fails to meet the specified conditions or requirements during shop testing, the pump manufacturer shall modify the pumping unit and perform additional tests. The pump manufacturer shall submit complete pump test reports, including test arrangement, instrumentation calibration data, test procedures, & test data in curve format.
- B. Each pump shall be subjected to a non-witnessed factory hydrostatic test per ANSI/HI 1.6.

## PART 3 EXECUTION

### 3.1 SHIPMENT

- A. All equipment shall include a stainless steel nameplate including the equipment tag number.
- B. The interior of the equipment shall be clean and free from debris.
- C. Provide and label lifting points for all pump components.

### 3.2 INSTALLATION

- A. Provide all manufacturer recommended lubricants for the pump and motor.
- B. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation, and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of ENGINEER.
- C. Install the pump per ANSI/HI 1.4. Ensure that pump flanges are properly aligned prior to installing bolts. Do not allow any piping strain to be transmitted to the pump.
- D. The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

- E. All costs of these services shall be included in the contract price for the number of days and round trips to the site as required.

### 3.3 *FIELD QUALITY CONTROL*

- A. Bump motor to ensure proper rotational direction.
- B. Perform field vibration measurements during normal operation. Vibration levels shall be within HI limits. Repair or replace pumps not meeting the HI vibration limits.
- C. Collect flow and discharge pressure data from at least three different flow rates, including the design flow rate. Compare the data with the factory performance curve and notify the Engineer if the data varies by more than 5%.

**END OF SECTION**

## **SECTION 43 32 83**

### **MANGANESE TREATMENT SYSTEMS**

#### **PART 1 GENERAL**

##### *1.1 DESCRIPTION*

- A. This section describes materials, fabrication, coating, filter media, testing, delivery and installation of complete pre-engineered manganese removal system described herein for the removal of manganese from groundwater.

##### *1.2 WORK TO BE INCLUDED*

- A. At a minimum, the manganese removal system supplier (Supplier) shall be responsible for design, fabrication, assembly, and delivery of complete manganese removal systems including all mechanical components, vessels, inter-vessel manifold piping, and instrumentation described in this specification section.
- B. Supplier shall provide the initial filter media. Filter media for the CSA 30 treatment system shall be the ATEC Pyrolox Advantage media or equal as approved by the engineer. Filter media for the CSA 32 site shall be the ATEC Pyrolox (AS-741M) media or equal as approved by the Engineer.
- C. Each manganese removal system shall be comprised of the following basic components to be provided by the supplier:
1. Filter Pressure Vessels.
  2. Hydraulically operated backwash valves
  3. Inlet, Outlet, and Backwash Manifolds
  4. Backwash Controller, UL Listed
  5. Backwash Flow meter
  6. Backwash Restrictor Valve.
  7. Skid Mounting
  8. Filter Media for each Vessel
  9. All immersed surfaces coated with a total dry thickness of at least 10 mils of ScotchKote 134 fusion epoxy coating, certified to ANSI/NSF Standard 61
  10. Exterior surfaces coated with a rust inhibiting primer and a polyurethane finish coat.
  11. Inlet and outlet connections made via flanges or grooved couplings as approved by Engineer.

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12. Seismic design of the vessel and manifold supports including definition of vessel anchorage requirements.
  13. Technical submittals and operation and maintenance manuals as described herein.
- D. The following work will be completed by the Contractor unless otherwise agreed between the Supplier and the Contractor:
1. Pilot testing of the manganese treatment system prior to start-up.
  2. Concrete foundation.
  3. System offloading from delivery truck.
  4. Field assembly of system components and system installation.
  5. Leak testing and disinfection of systems prior to start up.
  6. Supply and installation of anchor bolts for foundation.
- E. The following work will be completed by the Owner.
1. Confirmation bacteriological testing of the vessels after initial disinfection by the Contractor. Subsequent re-tests will be at the Contractor's expense.

### 1.3 RELATED WORK

- A. Section 09 90 00 – Painting and Coating
- B. Section 33 13 00 – Disinfection of Water Distribution System
- C. Section 40 05 00 – Pipe and Fittings

### 1.4 SUBMITTALS

- A. Provide vessel specifications including design pressure, dimensions, capacity, underdrain, and distributor configuration.
- B. Provide Supplier's qualifications per 1.5 of this section.
- C. Provide manganese treatment system process flow diagrams showing all valves, components, and instrumentation.
- D. Provide manganese treatment system general arrangement drawing showing dimensions, weights, and elevations and all nozzle locations. Label all valves, sample taps, and lines.
- E. Estimate of backwash frequency and backwash water volume.
- F. Exterior finish coating color charts.

G. Shop Drawings

1. Catalog cuts for purchased components and details for manufactured components. Identify materials, surface preparation, and finishes. Include calculations of wall thickness for vessel.
2. Structural and seismic calculations for vessels, piping, manifold supports, and appurtenances. Include calculations for reactions at anchor bolts and selection of the size and number of bolts required. Calculations shall be prepared by a Civil or Structural Engineer licensed in the state of California.
3. Shop inspection procedure and schedule.
4. Plan and elevation AutoCAD .DWG or .DXF files.

H. Test Reports - The following test reports shall be provided:

1. Pilot test report verifying the suitability of the media used per manganese treatment system. Reports shall be furnished no later than the time of the delivery of the vessels.
2. Pressure test reports and certificates of inspection for each vessel in accordance with procedures for ASME pressure rating and ASME Boiler and Pressure Vessel Code. Reports shall be furnished not later than the time of delivery of the vessels.
3. Factory test and inspection reports regarding all factory-applied linings and coatings for vessels and piping. Reports shall indicate that the linings and coatings have been applied in accordance with these specifications on surfaces receiving the specified preparation. Records of film thickness and holiday testing shall be included. Reports shall be furnished not later than the time of delivery of the vessels.

I. Supplier's Installation Instructions - Prior to shipment of systems, Supplier shall submit:

1. Instructions for the field personnel on handling and installation of the systems.

J. Filter Media

1. Prior to acceptance the submittal must include the following information:
  - a. Standard product datasheets
  - b. Temperature-specific media downflow pressure drop curves
  - c. NSF-61 certification
  - d. Backwashing instructions.



- e. A list of site features and Owner activities required to support media delivery.

#### 1.5 *REQUIRED QUALIFICATIONS FOR FILTER MEDIA SUPPLIER*

- A. The supplier shall include in their proposal documentation describing their supply and delivery experience and facilities. Sufficient information shall be provided to assure the Owner that the Supplier can fulfill its obligations under the contract.
- B. Supplier shall provide references for at least three similar manganese treatment projects completed within the last five years with the bid proposal.

#### 1.6 *REGULATORY REQUIREMENTS*

- A. The Supplier shall comply with all applicable regulatory requirements including, but not limited to, the following:
  - 1. Occupational safety and health requirements of OSHA and Cal-OSHA.
  - 2. U.S. Department of Transportation requirements for transportation of all materials.
  - 3. ANSI/NSF-61 certification of all components, filter media, and coatings in contact with the potable water.
  - 4. California lead-free requirements (AB 1953)
- B. The Supplier shall obtain all necessary permits related to the manufacture, coating and delivery of the system at their own expense.

#### 1.7 *DESIGN CRITERIA*

- A. Seismic - The manganese treatment systems shall be designed to meet current California Building Code seismic requirements.
- B. Anchorage: Design the manganese treatment systems and the associated supports and anchor bolts to support the equipment per CBC, Section 1613 and ASCE 7-16, Chapters 13 and 15
- C. Seismic design criteria for CA 30
  - 1. Occupancy Category: U
  - 2. Importance Factor: 1.25
  - 3. Seismic Design Category: III
  - 4.  $S_s$ : 1.429
  - 5.  $S_1$ : 0.477

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6.  $S_{DS}$ : 0.953
7.  $S_{D1}$ : null
8.  $S_{MS}$ : 1.429
9.  $S_{M1}$ : null
10.  $F_a$ : 1.0
11.  $F_v$ : null

D. Seismic design criteria for CSA 32

1. Occupancy Category: U
2. Importance Factor: 1.25
3. Seismic Design Category: III
4.  $S_s$ : 1.29
5.  $S_1$ : 0.431
6.  $S_{DS}$ : 0.86
7.  $S_{D1}$ : null
8.  $S_{MS}$ : 1.29
9.  $S_{M1}$ : null
10.  $F_a$ : 1
11.  $F_v$ : null

E. CSA 30 Wind Design shall conform to the CBC:

1. Risk Category: IV
2. Wind Velocity: 104 mph
3. I: 1.0
4.  $K_d$ : 1.0
5. Exposure Category: C
6.  $K_{zt}$ : 1.0
7. G: 0.85

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8.  $K_z$ : 0.85
9.  $K_h$ : 0.85
10.  $q_z$ : 24 psf
11.  $C_f$ : 0.63

F. CSA 32 Wind Design shall conform to the CBC:

1. Risk Category: IV
2. Wind Velocity: 104 mph
3. I: 1.0
4.  $K_d$ : 1.0
5. Exposure Category: C
6.  $K_{zt}$ : 1.0
7. G: 0.85
8.  $K_z$ : 0.85
9.  $K_h$ : 0.85
10.  $q_z$ : 24 psf
11.  $C_f$ : 0.63

G. Functionality

1. The equipment and all components shall not undergo loss of their intended function after application of the Design Earthquake Motions.
2. The Design Earthquake Motions shall be represented by the Design Response Spectrum (Figure 16-3) of the UBC and modified by multiplying the spectral accelerations by the Importance Factor,  $I = 1.50$ .

H. Hydraulic Capacity - The manganese treatment system shall have the following hydraulic capacities:

1. CSA 30: minimum 20 gallons per minute per vessel, 60 gpm system minimum total.
2. CSA 32: minimum 57 gallons per minute per vessel, 170 gpm system minimum total.

3. Each system shall be capable of meeting the design minimum total flow during normal operation with one vessel off-line.
- I. Vessel Size – Filter tank diameter and overall tank height shall be the following:
    1. CSA 30: Filter tank outside diameter shall be 2 feet nominal or as approved by Engineer. The overall height shall not exceed 8 feet from the bottom of the support structure to the uppermost portion of the vessel and piping or as approved by Engineer.
    2. CSA 32: Filter tank outside diameter shall be 2 and half feet nominal or as approved by Engineer. The overall height shall not exceed 10 feet from the bottom of the support structure to the uppermost portion of the vessels and piping or as approved by Engineer.
  - J. System Design and Operating Pressure - Filter tanks, piping, valves, and appurtenances subject to internal pressure during normal operation, backwashing (reverse normal water flow direction), or filter media filling or removal shall be designed, rated, and constructed for a working pressure of not less than 150 psig at 65°C (150°F). Normal operating pressure on the inlet and outlet manifolds is expected to be between 40 and 70 psig.
  - K. System Design Orientation - The filter tanks shall be aligned along a common centerline. The orientation of vessel appurtenances shall be as shown on the drawings. The maximum overall length from the outside of the first vessel to the outside of the last vessel shall be as shown in the drawings. The manganese treatment system influent, effluent and backwash nozzles shall be oriented as required to accommodate the site yard piping at each of the well sites.

## 1.8 *MODES OF OPERATION*

- A. Standard: Forward flow through all vessels.
- B. System Backwashing: The vessels shall be capable of operating in a backwash mode using water treated by other vessels in the system.

## 1.9 *WARRANTY*

- A. The Supplier shall warranty the manganese treatment system against the following conditions occurring within three years of the tanks entering service:
  1. The Supplier shall warrant against any defects in workmanship or materials for all equipment, coatings, valves, and controls.
  2. The Supplier shall warrant that, under actual operating conditions: (1) the media shall not be washed out of the system during the service run or backwashing period, and (2) the under-drain system, gravel, and media shall not become fouled, either with turbidity or by other particles, while operating as specified by the manufacturer.

3. The manufacturer shall guarantee that: (1) the manganese will be removed at all times except during and immediately following the backwash cycle for a period not to exceed five (5) minutes to a content level of 50% or less of the current secondary MCL of 0.05 mg/L, respectively; (2) that filtered water turbidity shall be less than 1.0 NTU; and, (3) that filtered water color shall be less than 5 standard color units. These levels shall be maintained with no more than two backwash cycles per 24-hour period under normal operating conditions.

## **PART 2 MATERIALS**

### **2.1 ALLOWABLE SUPPLIERS**

- A. The system shall be manufactured by ATEC (Bill Ketchum: 360-414-9223), AdEdge Water Technologies, LLC (Doug Craver 480-243-1824) or equal as approved by Engineer. The systems shall be supplied as a complete and integrated package.
- B. Contractors shall not be allowed to source individual components from one of the listed suppliers to self-assemble the manganese treatment vessel systems.

### **2.2 MANGANESE TREATMENT SYSTEMS COMPONENTS**

- A. The systems shall be shipped to the job site in the least number of pieces permissible for transportation.

### **2.3 FILTER TANKS**

#### **A. CSA 30 TREATMENT SYSTEM**

1. Tanks shall be of electric welded pressure vessel quality low carbon steel construction rated for 150 psig working pressure and hydrostatically tested at 100% in excess of the working pressure. Sidewalls shall be built of Grade SA-572 steel and tank heads (Tank heads shall be fabricated of Grade SA-516-70 Steel) and hand-holes shall comply with ASME Code requirements. Sidewalls shall be at least ¼" nominal gauge and heads shall be at least ¼" nominal gauge.
2. Tanks shall have stainless steel grooved coupling connections on the service inlet and outlet. Manifolds shall have a flanged connection on the system inlet and outlet.
3. Access opening for tanks shall include one manhole in the top head one circular access ports in lower sidewall of tank as close to lower head as possible to allow for under drain servicing or media removal.
4. Support for tanks shall be structural steel angle iron legs welded to lower section of the sidewall.

5. Filter vessels shall be mounted to a common 4" x 6" x ¼" tubular steel frame (skids) with forklift brackets and four crane lifting hooks. The skids will be sandblasted and epoxy coated.
6. This treatment system shall consist of one skid with a minimum of four filter vessels. Filter vessels shall be mounted so that they can be removed individually with the use of standard hand tools and a forklift or similar lifting device.
7. Gussets with oversized bolt holes shall be provided at each inside corner of the skid to allow the system's attachment to the floor by anchor bolts which shall be provided by the Contractor. Number and size of bolts shall be determined by manufacturer's engineer.
8. Seismic anchorage shall be provided and integral to the filter skids. Anchors shall be placed in the general locations shown on the drawings. Anchor plates shall be welded to the skids and factory coated with the exterior coating system described in section 2, below. Provide a copy of the structural engineer's report prior to shipment.
9. The filter system shall be a "down-flow" type with untreated water entering the top of the filter and flow through the filter tank and out the bottom of the tank.
10. The upper distribution system shall be of the baffle type to evenly distribute the water over the entire tank area.

**B. CSA 32 TREATMENT SYSTEM**

1. Tanks shall be of electric welded pressure vessel quality low carbon steel construction rated for 150 psig working pressure and hydrostatically tested at 100% in excess of the working pressure. Sidewalls shall be built of Grade SA-572 steel and tank heads (Tank heads shall be fabricated of Grade SA-516-70 Steel) and hand-holes shall comply with ASME Code requirements. Sidewalls shall be at least ¼" nominal gauge and heads shall be at least ¼" nominal gauge.
2. Tanks shall have stainless steel grooved coupling connections on the service inlet and outlet. Manifolds shall have a flanged connection on the system inlet and outlet.
3. Access opening for tanks shall include one manhole in the top head one circular access ports in lower sidewall of tank as close to lower head as possible to allow for under drain servicing or media removal.
4. Support for tanks shall be structural steel angle iron legs welded to lower section of the sidewall.
5. Filter vessels shall be mounted to a common 4" x 6" x ¼" tubular steel frame (skids) with forklift brackets and four crane lifting hooks. The skids will be sandblasted and epoxy coated.

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6. This treatment system shall consist of one skid with four filter vessels minimum. Filter vessels shall be mounted so that they can be removed individually with the use of standard hand tools and a forklift or similar lifting device.
  7. Gussets with oversized bolt holes shall be provided at each inside corner of the skid to allow the system's attachment to the floor by anchor bolts which shall be provided by the Contractor. Number and size of bolts shall be determined by manufacturer's engineer.
  8. Seismic anchorage shall be provided and integral to the filter skids. Anchors shall be placed in the general locations shown on the drawings. Anchor plates shall be welded to the skids and factory coated with the exterior coating system described in section 2, below. Provide a copy of the structural engineer's report prior to shipment.
  9. The filter system shall be a "down-flow" type with untreated water entering the top of the filter and flow through the filter tank and out the bottom of the tank.
  10. The upper distribution system shall be of the baffle type to evenly distribute the water over the entire tank area.
- C. Vessel Nozzles: Each vessel shall be provided with a minimum of the following nozzles:
1. Minimum 4-inch-diameter raw water inlet.
  2. Minimum 4-inch-diameter treated water outlet.
  3. Minimum 4-inch-diameter inlet for loading filter media.
  4.  $\frac{3}{4}$ " threaded half coupling shall be provided on the inlet and outlet manifold for such use as the customer may deem appropriate.
  5. A combination air and vacuum release valve installed at the high point of the vessel.
  6. A 2" threaded connection shall be provided on the inlet manifold for owner mounting of an air relief valve.

## 2.4 LINING

- A. The interior of the vessel and manifold immersion service surfaces shall be coated with 3M Company ScotchKote 134, an epoxy fusion coating which conforms to the requirements of ANSI/NSF Standard 61 for contact with potable water and the requirements of AWWA Standards C550 and C213, applied in accordance with the manufacturer's recommendations to a total dry film thickness of at least 10 mils, applied in one or more coats; or an approved equal. Interior lining must be certified to NSF/ANSI Standard 61 for direct potable water contact.

- B. The surface preparation (after grinding all welds and sharp edges smooth/radiused), and lining application including testing shall be certified by an independent third-party Inspector selected and paid for by the Supplier.
- C. Surface Preparation:
1. Degrease surfaces prior to sandblasting to completely remove dirt, grease, oil, etc.
  2. Sandblast to SSPC-SP5/NACE 1 White Metal using a venturi blast nozzle at 100 psi minimum.
  3. The degree of blast profile shall be a minimum of 4 mils.
  4. Remove all traces of grit and dust and imbedded abrasives with a vacuum cleaner.
- D. Lining inspection shall include:
1. General Appearance: film shall be free of runs, sags, orange peel, pinholing, fish-eyes, over-spray, trash in the film and voids.
  2. Film thickness shall be determined using a Micro test thickness gauge as manufactured by KTA-Tater, Inc. or functionally equivalent non-destructive day film thickness gauge for use on protective coatings with an accuracy of  $\pm 5\%$ , and which has been properly calibrated.
  3. Discontinuity void testing shall be performed using a voltage detector Midel AP-W as manufactured by Tinker and Rasor (San Gabriel, CA). Void testing shall only be performed after all interior manifold piping and other internal equipment has been completely installed.
  4. The Supplier shall pay for all of the above coating testing and any required re-testing of the lining prior to shipment.
  5. Detailed requirements for lining inspection shall be as further described in Carboline Bulletin PA-3.
- E. At the Owner's cost and discretion, additional void testing may be conducted at the project site after delivery. Any voids or cracks found will be repaired and retested by the Supplier, at his expense.

## 2.5 PROCESS AND UTILITY PIPING

- A. General
1. All pipe which will operate under pressure shall be properly tied or blocked, restrained, and supported at all fittings where the pipe changes direction, changes size, or ends, using suitable anchors. Exposed pipe shall be installed in straight runs parallel to the axis of the structures or equipment.



Pipe runs shall be horizontal and vertical except that gravity drain lines shall be pitched down in the direction of flow not less than 1/8 inch per foot.

2. Piping shall be made up with a sufficient number of unions, flanged joints, grooved end joints, or flexible couplings to permit ready breaking of lines as necessary for inspection and maintenance and to allow for expansion and contraction and general flexibility.
3. Pipe and fittings shall be assembled so there will be no distortion or springing of the pipelines. Flanges, unions, flexible couplings, and other connections shall come together at the proper orientation. The fit shall not be made by springing any piping nor shall orientation or alignment be corrected by taking up on any flange bolts. Flange bolts, union halves, flexible connectors, etc., shall slip freely into place. If the proper fit is not obtained, the piping shall be altered to fit.
4. Piping shall be designed for a maximum liquid velocity of 6.5 fps unless otherwise noted. Supplier shall submit calculations to verify that requirements for maximum headloss and velocity are met with the proposed piping design. Noise generation shall be a consideration in the selection of size for pipe and valves.
5. Exceptions to the maximum velocity requirement may be permitted on relatively short piping runs where the treated water line can serve as the backwash inlet and where the raw water line serves as the backwash outlet.
6. Pipe shall be fusion-bonded epoxy coated and lined or liquid epoxy coated and lined as described below unless otherwise indicated in this specification. The coating material shall be compliant with ANSI/NSF-61.
  - a. For fusion epoxy-lined and coated steel pipe, the coating material shall be a 100 percent powder epoxy applied in accordance with ANSI/AWWA C213. The coating shall be applied using the fluidized bed or electrostatic spray process. Coating DFT = 16 mils, Scotchkote 134 (electrostatic) or 206N (fluidized bed), or equal, applied in one coat.
  - b. For liquid epoxy-lined and coated steel pipe, the coating material shall be liquid epoxy applied in accordance with ANSI/AWWA C210. The coating system shall consist of one coat of a two-part chemically cured inhibitive epoxy primer, and one or more coats of a two-part chemically cured epoxy finish coat for a total DFT = 16 mil. TNE MEC Epoxoline Series 141, Carboline Carboguard 891, or equal.
7. Apply topcoat to exterior of fusion epoxy-lined and coated steel pipe to match color of vessel.
8. Raw and treated water manifold and piping shall be as specified on construction drawings.

9. Backwash piping shall be Schedule 40 steel unless otherwise specified.
  10. Immersed portions of manifolds shall be coated with a fusion epoxy coating, certified to ANSI/NSF Standard 61 in the same manner specified for filter vessels above.
  11. A 2" threaded connection shall be provided on the inlet manifold for owner mounting of an air relief valve.
- B. Piping 4 Inches and Smaller
1. Unless otherwise specified, piping shall be Schedule 40 black carbon steel conforming to ASTM A 53, Grade B, Type E or S, or ASTM A 135.
  2. Fittings shall be flanged, screwed, or grooved-end.
- C. Piping Larger Than 4 Inches
1. Unless otherwise specified, piping shall be Schedule 40 black carbon steel conforming to ASTM A 53, Grade B, Type E or S.
  2. Fittings shall be flanged or grooved-end.
- D. Air Piping 2 Inches and Smaller
1. Unless otherwise specified, piping shall be Schedule 40 black carbon steel conforming to ASTM A 53, Grade B, Type E or S.
  2. Fittings shall be screwed, welded, or flanged.
- E. Vessel influent piping shall be top entry provided that the overall vessel height requirement is met.

## 2.6 PROCESS VALVES

- A. General
1. The Supplier shall furnish all valves as called for in these specifications, or as required for proper operation of the equipment in general. Valves shall be manufactured by a Manufacturer whose valves have had successful operational experience in comparable service.
  2. Wherever stainless steel is specified in this section, it shall be Type 316 or Type 304 unless otherwise specified. Where dissimilar metals are being bolted, stainless-steel bolts shall be used.
  3. The Supplier shall furnish all incidental materials necessary for installation of the valves such as flange gaskets, flange bolts, nuts and washers, and all other materials required for the complete installation.
- B. Main Operating Valve

1. The main operating valve on each tank shall be an industrial automatic multi-port diaphragm type, slow opening and closing, free of water hammer.
2. The diaphragm assembly shall be fully guided on its perimeter when pressure activated from one position to another to assure a smooth reliable shut-off without sticking.
3. There shall be no contact of dissimilar metals within the valve and no special tools shall be required to service the valve. The valve shall be actuated pneumatically.
4. The operating valve shall be a Bermad IR-4X4/3-350-A-I Backwash Valve, or approved equal, the wetted surfaces of which shall be coated with a NSF/ANSI Standard 61 fusion epoxy coating.

C. Backwash Valve

1. An adjustable backwash flow restrictor to assure proper backwashing will be provided by the supplier.

D. Pilot Control Valve

1. The multi-ported pilot control valve shall be pre-connected to automatically pressure activate the main operating valve through the steps of backwash and return to service.
2. Pilot control valves shall be rated for 120 VAC at 60 Hz.
3. Pilot control valves shall be Peter Paul Electronics Series 58 or equal as approved by the Engineer.

## 2.7 FLOW METERS

- A. Each vessel shall be equipped with a flow meter consisting of a sensor and transmitter capable of measuring flow in the forward direction and backwash flow in the reverse direction.
- B. Refer to specification section 40 91 25 for flow meter requirements.
- C. Flow indicators shall be mounted in a location visible to operators and shall include a sun-cap or sun-shade designed for continuous exposure to direct sunlight, durable, and sufficient to protect the indicator screen from sunlight.

## 2.8 MISCELLANEOUS

- A. Pressure Gauges: The vessel manifold piping shall be equipped with liquid filled pressure gauges in corrosion resistant frames to indicate the pressure of water entering and exiting each vessel. Connection size shall be ½ inch. Range shall be 0-300 psi with an accuracy of ½ percent of full range. Gauges shall not be less than 4 ½ inches in diameter with surge suppression snubbers and will be mounted near the backwash controller. Pressure gauge assemblies shall be isolated from

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process piping with a ½ inch bronze ball valve. Gauges shall have stainless steel or bronze bourdon tube and be fitted with shatterproof glass. Gauges shall be manufactured by Ashcroft, Crosby, Marshalltown, Marsh, or equal.

B. Sample Piping

1. The following sample taps shall be provided as a minimum:
  - a. Composite sampling port for raw water
  - b. Composite sampling port for finished water
  - c. Sampling port for sampling backwash effluent
2. The sample piping shall be ½ inch diameter stainless steel tubing with ½ inch diameter stainless steel ball valves.

2.9 PAINTING AND COATING

- A. The exterior of the vessel, supports, piping (including air vent piping) and appurtenances shall be coated with a 2-part catalyzed epoxy primer followed by a urethane topcoat
- B. All surfaces shall be prepared for coating in accordance with SSPC SP-6
- C. Prime Coat: Apply 2 - 3 mils dry film thickness of a rust resistant primer, or equal.
- D. Finish Coat: Apply 1.5 – 2.5 mils dry film thickness of Cardinal 6400 Series Polyurethane or equal.
- E. Surfaces Not to be Coated: Aluminum, brass, bronze, copper, plastic, rubber, or stainless steel. Grease fitting, nameplates, or serial numbers.
- F. Any galvanized piping used on the treatment vessels shall be painted to match.
- G. The color shall be True Blue (Cardinal 6407 J02 500-U) for the filter and manifolds and ANSI Gray (Cardinal 6407 GR16-U) for the valves and fittings. No supplier logo shall appear on the vessels without approval of the Owner.

2.10 MANGANESE TREATMENT FILTER MEDIA

- A. General
  1. The filter media shall be a granular material having both oxidizing and catalytic properties for iron and manganese removal.
- B. Physical Characteristics
  1. The size of the media shall be 20-40 U.S. Mesh.
  2. The media is NSF Certified to ANSI/NSF Standard 61.

3. The Media shall operate on in a pH range of 6.5 to 10.0.
4. Media regeneration is not required.
5. Chlorine is the oxidant that will be used on this system. No oxidant other than chlorine is authorized for use in this system.

## **PART 3 EXECUTION**

### **3.1 OWNER OVERSIGHT**

- A. The Owner reserves the right to visit all fabrication facilities and perform independent inspections of materials and coatings at any time during the fabrication period. Such visits and inspections shall be at the Owner's expense but will not result in any additional compensation to the Supplier.

### **3.2 DELIVERY**

- A. All vessel openings, including manways and nozzles, shall be securely covered in the factory prior to shipment to prevent the entrance of debris and animals.

### **3.3 INSPECTION**

- A. The Owner may retain the services of an independent, third-party testing entity to inspect the linings and coatings of the vessels once they arrive on-site. The supplier shall provide all materials, labor and equipment necessary and bear all costs associated with repair of the linings and coatings if holidays or other defects are identified during the inspection.

### **3.4 INSTALLATION**

- A. Installation of the manganese treatment systems and related appurtenances shall be performed by the Contractor unless otherwise agreed between the Supplier and the Contractor, and will be in accordance with the Supplier's drawings, instructions, and recommendations.

### **3.5 START-UP SERVICES AND TESTING**

- A. The Contractor and Supplier shall make available the services of a factory authorized service representative for two days to supervise, inspect and provide operator training during the initial start-up.

### **3.6 DISINFECTION**

- A. The interior of the vessels and manifold piping shall be free of debris when received at the job site. The equipment shall be in a condition to be immediately pressure tested and disinfected without cleaning or extensive flushing required.
- B. Disinfection of the vessels and manifold piping shall be by the Contractor unless otherwise agreed between the Supplier and the Contractor.

- C. The treatment vessels and manifold piping shall be disinfected per the requirements of Section 33 13 00 and shall follow the procedures in AWWA C652, Chlorination method 1 or an alternate method approved by the Owner.
- D. The treatment system shall be sampled and tested for coliform and HPC bacteria after disinfection. Filter media shall not be loaded into the vessels until non-detect results are achieved.
- E. The supplier shall be responsible for as many disinfection cycles as are necessary to obtain non-detect coliform results.

### 3.7 DELIVERY AND INSTALLATION OF MANGANESE TREATMENT SYSTEM

- A. Following disinfection of the manganese treatment vessels, each vessel shall be filled with filter media in accordance with these specifications.
- B. Total coliform and HPC test results following disinfection of the empty vessels will be made available to the Supplier. Should the supplier wish to independently confirm the bacteriological quality of the water in the vessels or in the County's water supply, it shall be at their own expense.
- C. Delivery shall be during normal business hours.

### 3.8 MATERIAL TESTING AND START-UP

- A. Following completion of initial backwashing of the newly delivered filter media, samples will be collected by the Owner from the vessel influent water or the distribution system (whichever is the source of the backwash water) and the system effluent sample port. This sample will be analyzed by a State of California certified laboratory for bacteriological contamination. Refer to Warranty requirements in Part 1 of this specification.
- B. Contaminated filter media shall be disinfected or replaced at the Supplier's expense, including all costs for materials, labor, and chemicals. If the filter media tests positive for fecal coliform or Escherichia Coli in both initial and confirmation samples, the filter media shall be rejected and must be removed and replaced after re-disinfection of the vessel(s).
- C. The new system, pump, and manganese treatment shall be operational and tested for a minimum of 3 days or until Division of Drinking Water approves the system to be connected to the distribution system. The water produced during the commissioning period shall be sent to the storm drain installed as part of the project. During commissioning, water will be tested in the influent and effluent to meet minimum parameters as stated in part 1.9.D.
- D. Backwash samples will be collected by the Owner. The sample will be analyzed by a State of California certified laboratory for manganese levels.
- E. A demonstration of performance off all instruments is required prior to commissioning.

### 3.9 INSTRUCTIONS

- A. Three complete sets of *Manganese Systems' Installation, Operating and Maintenance Manual* are included with the treatment system. A copy of the O&M manual shall also be provided on a CD in a searchable Adobe PDF format. The O&M manual includes schematics of electrical controls.

**END OF SECTION**

## **SECTION 43 41 43**

### **VERTICAL POLYETHYLENE CHEMICAL STORAGE TANKS**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. This section includes materials, testing, and installation of cross-linked high-density vertical polyethylene storage tanks for chemical service.

##### **1.2 RELATED WORK**

- A. Section 40 05 00 - Pipe and Fittings
- B. Section 40 05 23 – Valves and Appurtenances

##### **1.3 REFERENCES**

- A. American Water Works Association (AWWA)
- B. American Society for Testing and Materials (ASTM)
- C. American National Standards Institute (ASNSI)

##### **1.4 SUBMITTALS**

- A. Submit shop drawings in accordance with the General and Special Conditions.
- B. Submit tank manufacturer's data and dimensions showing locations of all openings, locations of level indicators, seismic support structure and anchoring system details, and location of tank accessories.
- C. Submit details on inlet and outlet fittings, manways, vents and level indicators.
- D. Submit statement by the manufacturer certifying compatibility of the tank materials with the chemicals to be stored.
- E. Submit manufacturer's warranty.
- F. Submit supporting documentation of Manufacturer's certification to NSF/ANSI Standard 61 – Drinking Water System Components for water treatment chemicals.

##### **1.5 QUALITY ASSURANCE**

- A. All materials in contact with potable water or chemicals used for potable water treatment shall be ANSI/NSF-61 certified.



- B. The tanks shall be warranted to be free of defects in materials and workmanship for 5 years. Warranty shall be prorated over the last three years of the warranty term.

**PART 2 PRODUCTS**

**2.1 MANUFACTURERS**

- A. Tanks and appurtenances shall be high density cross-linked polyethylene tanks manufactured by Assmann Polyethylene Tanks, Snyder Industries, Poly Processing or equal.

**2.2 GENERAL**

- A. Tanks shall be circular in cross-section, vertical, complete with piping inlets and outlets, drains, overflows, and anchoring system. Covered tanks shall be vented. Tanks shall be marked to identify the manufacturer, date of manufacture, serial number, and capacity. Tanks shall meet the requirements of ASTM D1998 unless otherwise indicated

**2.3 TANKS**

- A. Materials: Polyethylene shall be of the cross-linked, high density type meeting or exceeding the following requirements:

<b>Parameter</b>	<b>ASTM Method</b>	<b>Value</b>
Density, gm/cc	D1505	0.937 to 0.945
Tensile Strength at yield, psi minimum	D638	2600
Elongation at break, min percent	D638	400
Stress-crack resistance, min hours for F50	D1693	1000
Vicat softening temperature, deg F	D1525	230
Brittleness temperature, deg F, maximum	D746	-180
Flexural modulus, psi	D790	100,000

Resin used in the tank shall be equal to Schulink XL350, Phillips Chemical Marlex CL-200 or CL-250, PAXON grade 7004 or 7204, or equal, and shall contain a minimum of 0.3 percent ultraviolet stabilizer as recommended by the manufacturer.

- B. Chemical storage tanks shall be suitable for the service conditions listed under that portion of this specification.
- C. Tanks shall be constructed using a rotationally molded fabrication process. Wall thickness of the tank shall be designed by the manufacturer with a hoop stress no greater than 600 psi using 1.5 times the specific gravity indicated. Stress shall be calculated using the Barlow formula.

#### 2.4 TANK FITTINGS

- A. Gasket material shall be compatible with the chemical service.
- B. No metals other than titanium shall be exposed to the tank contents.
- C. Any screwed fittings shall use American Standard Pipe Threads.
- D. Sidewall outlet / drain fitting: Fitting shall pass through the sidewall of both the primary and secondary tank on the flats provided by the secondary tank. A single 2-inch fitting serving as both outlet and drain shall be provided. The fitting shall be a metallic double male bolted style fitting. The metallic fitting shall be constructed out of titanium. Fitting shall be constructed to an ANSI 150 LB flange bolt hole pattern. A single Viton gasket shall be placed between the metallic fitting and the inside of the primary tank wall. A second gasket shall be installed between the outside of the primary tank and the inside of the secondary tank. All mounting hardware shall be compatible with the tank contents. The sidewall fitting shall be constructed in a manner as not to expose cross sections of tank walls as might otherwise result by installation of the fitting. Fitting shall be located on the lower sidewall of the storage tank on the recessed fitting placement flat. Tank shall be shipped with discharge nozzle installed. No additional fitting installation will be required onsite.
- E. Fill Pipe: The tanks shall be filled from the top. The fill line assembly shall consist of an exterior drop tube, 90-degree elbow, vented ball valve, male quick connect coupling, dust cap, interior drop tube, and pipe support brackets.
- F. Vents: Each tank shall be equipped with a minimum 2-inch diameter vent configured to vent outside of the chemical enclosure as shown on the plans. The vent inlet/outlet shall be downward facing and equipped with an insect screen.
- G. Tanks shall include a 16-inch manway cover at the top of the tank unless otherwise noted on the drawings.

#### 2.5 LEVEL INDICATION

- A. Float Indication: A float-type level indicator shall be assembled to the tank and shall consist of PVC float, indicator, polypropylene rope, PVC roller guides, clear UV

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resistant PVC sight tube, and necessary pipe supports. The level indicator shall act inversely to the tank contents and shall not allow entrance of tank contents into the sight tube at any time. Indicator shall be neon orange color for visual ease for onsite operators.

## 2.6 RESTRAINT SYSTEM

- A. The tanks shall be provided with seismic restraint systems designed by the manufacturer for the following California Building Code seismic design parameters:

Parameter	Value
$S_s$	0.601g
$S_1$	0.246g
Site Class	D
Design Category	D
$F_a$	1.319
$F_v$	2.108
PGA	0.340g
$S_{MS}$	0.793g
$S_{M1}$	0.519g
$S_{DS}$	0.529g
$S_{D1}$	0.346g

- B. The tanks will be installed inside of a shielded enclosure. Wind restraint is not required.
- C. Seismic restraint system components likely to be exposed incidentally to the process chemical, shall be fabricated from materials resistant to the process chemical.

## 2.7 SIGNAGE

- A. Each tank shall be clearly marked with hazardous material warning signs conforming to NFPA 704. Each tank shall also have a sign with the word "DANGER" and the name of the chemical stored, printed in large block letters and mounted directly adjacent to the tank outlet and tank inlet. Each entry manway shall be provided with a sign ("DANGER--CONFINED SPACE--HAZARDOUS ATMOSPHERE").

## 2.8 SERVICE CONDITIONS

- A. CSA 30 and CSA 32 Treatment Sites

<b>Chemical Service</b>	12.5% Sodium Hypochlorite
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<b>Tank Quantity</b>	2
<b>Location</b>	Inside of a covered enclosure
<b>Tank Volume, Min</b>	550 gallons
<b>Tank Dia, Nominal</b>	60"
<b>Tank Shell Height, Nominal</b>	73"
<b>Wind Exposure</b>	NA
<b>Level Indicator</b>	Float
<b>Color</b>	Opaque white
<b>Insulation</b>	NA
<b>Heat Tracing</b>	NA
<b>Ambient Temperature</b>	32 – 110 deg. F

### **PART 3 EXECUTION**

#### **3.1 FACTORY TESTING**

- A. Material taken from each tank shall be tested for the following in accordance with ASTM D1998:
  - 1. Impact (120 ft-lb minimum)
  - 2. Gel, minimum percent
    - a. 1/32-inch of inner wall: 65
    - b. Outer wall: 90
    - c. Total wall: 70
  
- B. Hydrostatic testing shall be done on all tanks to ensure a leak proof seal on all installed fittings and a certificate of compliance shall be sent with the tank.

### 3.2 *INSTALLATION*

- A. Installation shall be in accordance with the manufacturer's recommendations.

### 3.3 *FIELD QUALITY CONTROL*

- A. After installation of tank and all fittings, the tank shall be water tested by filling the entire tank with water and monitoring the tank as well as all fitting connections for at least 24 hours. Any leaks shall be corrected prior to acceptance. Following successful field tank testing, the tank shall be completely emptied and dried.

**END OF SECTION**

**SECTION 43 42 85**  
**HYDROPNEUMATIC TANK**

**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- A. Furnish and install concrete slab foundation.
- B. Furnish and install one 5,000-gallon hydropneumatic tank, including air system, piping, controls and appurtenances at both CSA 30 and CSA 32.

**1.2 RELATED WORK**

- A. Section 03 33 01 - Cast-in-Place Concrete (Site Work)
- B. Section 09 90 00 – Painting and Coating (Site Work)
- C. Section 31 23 00 - Earthwork
- D. Section 33 13 00 - Disinfection of Potable Water System
- E. Section 40 05 23 - Valves and Appurtenances
- F. Section 43 42 86 – Air Compressor

**1.3 REFERENCES**

- A. ASME Boiler and Pressure Vessel Code, Division 1, Section VIII.

**1.4 SUBMITTALS**

- A. Submittals shall be in accordance with the General Provisions.
- B. As specified in Section 01 33 00 – Submittal Procedures
- C. Submit shop drawings, manufacturer's literature, certificates and guarantees, seismic calculations and ASME forms U-1A and U-3.
- D. Submit of manufacturer's drawings showing the dimensions of the tank, connections, the thickness of all plates and the sections of all principal members. Manufacturer's design data and calculations shall bear the seal of the Professional Engineer registered in the State of California. Color samples for exterior coating shall be provided with the manufacturer's submittal.

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## **PART 2 PRODUCTS**

### **2.1 HYDROPNEUMATIC TANK**

- A. Materials for the tank, design, and shop fabrication and inspection shall comply with Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code with only the plate steels in Table UCS-23 of said code being used. Minimum design pressure shall be 100 psig. Provide tank with support structures, bearing plate, and neoprene pads prepared to be bolted to concrete footings. Perform hydrostatic test in shop. Test pressure shall be 150 percent of the design pressure defined above. Provide ASME code stamp and pressure rating on pressure vessel.
- B. Tank shall be fitted with two 14-inch by 18-inch elliptical access manholes in tank heads, outlets for pipe connection to system piping, threaded outlets for connecting gages, valves, air piping and drain outlet in the bottom of the tank as shown on the Plans.
- C. Outlets 2-inches and smaller shall be threaded couplings. Couplings shall be 3,000 pound minimum, WOG forged steel, per ASTM A 105, Grade 70, or ASTM A 216, Grade WCB. Threads shall comply with ANSI B1.20.1. Joint lubricant shall be Teflon joint compound or Teflon tape.
- D. Outlets larger than 2-inches shall be of the flanged nozzle type. Nozzles shall be schedule 80 per ANSI B36.10. Flanges shall be Class 150 per ANSI B16.5. Flanges shall be flat faced. Outlets larger than 4" shall be equipped with anti-vortex baffles.
- E. Tank shall be supplied complete with control panel in stainless steel NEMA 3R cabinet mounted to tank as shown on Plans. Control panel shall be complete with Mercoid Switch, pressure gage, site glass, light, heater and wiring as shown on electrical drawings. A spare site glass tube, in a protective wrapper, shall be furnished with the panel.

### **2.2 SAFETY RELIEF VALVE**

- A. Safety relief valve shall comply with the ASME Boiler and Pressure Vessel Code for air service. Valve shall close when pressure drops to allowable range. Valve size shall not be less than that required to maintain the hydropneumatic tank at its ASME design pressure while the air compressor is discharging at that pressure. Valves shall have a pressure rating of at least 250 psi WOG. Valve bodies shall be bronze (ASTM B 61 or B 62) or Type 304 or 316 stainless steel with bottom inlet and side outlet. Inlet shall have male threads, ANSI B1.20.1. Valve shall incorporate a calibrated spring set to allow the valve to open at a pressure of 80 psi. Valve shall be Kunkle Model 6010, Dresser-Consolidated Series 1982, or Engineer approved equivalent. Valve shall be sized per the tank manufacturer's recommendations

Valve shall be sized per the tank manufacturer's recommendations.

### 2.3 AIR SYSTEM

- A. As specified in Section 43 42 86 – Air Compressor.

## PART 3 EXECUTION

### 3.1 FOUNDATION AND ANCHORING

- A. Concrete shall be constructed in accordance with Section 03 30 00, "Cast-in-Place Concrete", and with the tank manufacturer's seismic calculations.
- B. Anchoring shall be in conformance with tank manufacturers seismic calculations and recommendations.

### 3.2 PROTECTIVE COATINGS

- A. As specified in Section 09 90 00 – Painting
- B. Inside Surfaces:
  - 1. Type: Epoxy - shop applied.
  - 2. Service Conditions: For use with structures, piping, or equipment immersed in potable water.
  - 3. Surface Preparation: SSPC SP-10.
  - 4. Coating System: Apply the manufacturer's recommended number of coats to attain the specified minimum dry-film coating thickness. Products: Devoe Bar-Rust 233H, Tnemec 100, Scotchkote 323, Tnemec N140, Sherwin-Williams Tank Clad HS B62-80, Scotchkote 306, PPG AQUAPON® LT NSF Low Temperature Epoxy Coatings 95-172, Carboline Carboguard 891, PPG Amercoat 395FD, Carboline Plasite 7133 or 9133, Keysite 740, or equal;
- C. Outside Surfaces:
  - 1. Type: Gloss alkyd enamel having a minimum volume solids content of 46 percent with alkyd primer.
  - 2. Service Conditions: For use on exterior metal and piping subject to sunlight and weathering.
  - 3. Surface Preparation: SSPC SP-6.



4. Shop Applied Prime Coat: Koppers 622HG, Tnemec 4-55 or Ameron 5105, applied to minimum dry film thickness of two mils.
5. Field Applied (After Installation) Finish Coat: One coat of Koppers 500HB enamel, 3.0 mils; two coats of Tnemec Series 2H, 2.5 mils each; or two coats of Ameron 5401 HS, 1.5 mils each.

### 3.3 *DISINFECTION AND TESTING*

- A. Tank shall be disinfected by jet washing of the interior of the lined tank with a chlorine solution of 300 ppm to 500 ppm. A chlorine product free of acid components shall be used. Contractor shall drain the chlorine solution which accumulates in the bottom of the tank the same workday it is applied. Rinsing with clean water is not required.
- B. Testing shall be in accordance with ANSI/AWWA C652

**END OF SECTION**

## **SECTION 43 42 86**

### **AIR COMPRESSOR**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. Furnish and install air compressor to supply service air to the hydropneumatic tank, including all connections for air system, piping, concrete foundation, controls and appurtenances.

##### **1.2 RELATED WORK**

- A. Section 31 23 00 - Earthwork
- B. Section 44 05 00 - Pipe and Fittings
- C. Section 40 05 23 - Valves & Appurtenances
- D. Section 43 42 85 - Hydropneumatic Tank
- E. Section 03 30 01 - Cast-in-Place Concrete (Site Work)

##### **1.3 SUBMITTALS**

- A. Submit copies of shop drawings, manufacturer's literature, certificates and guarantees, seismic calculations and ASME forms U-1A and U-3.
- B. Submit copies of manufacturer's drawings showing the dimensions of the tank, connections, thickness of all plates, and sections of all principal members. Manufacturer's design data and calculations shall bear the seal of the Professional Engineer registered in the State of California. Color samples for exterior coating shall be provided with the manufacturer's submittal.
- C. Submittals shall be in accordance with the General Conditions and Section 01 33 00 – Submittal Procedures.

#### **PART 2 PRODUCTS**

##### **2.1 AIR SYSTEM**

- A. The air system shall include oil-less air compressor with 80-gallon receiver and controls; water level probes; piping; check valve and miscellaneous valves and controls and shall provide an air charging system to automatically maintain the water level in the hydropneumatic tank.

Air Compressor  
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- B. The Contractor shall coordinate the requirements of the compressor supplier with the manufacturer or supplier of the hydropneumatic tank to ensure that tank is manufactured with all required connections.

## 2.2 AIR COMPRESSOR

- A. The air compressor shall be oil-less air single stage compressor with 80-gallon receiver and controls and shall have a capacity of 8.3 CFM at 100 psig. Compressor shall be a Quincy #QRDS-3-80S, or approved Engineer approved equivalent with the following accessories:
  - 1. Outdoor filter / silencer
  - 2. 3 H.P., 800 RPM, 480 V, 3 phase, TEFC motor with NEMA 3R starter and pressure switch pre-wired.
  - 3. 80-gallon ASME code horizontal receiver with safety valve, gauge, and necessary fittings.
  - 4. V-belt drive with belt guard
  - 5. Magnetic starter control, mounted and wired with electronic overloads with phase unbalance protection.
  - 6. Automatic 120 volt pre-wired solenoid tank drain with time of day timer and manual tank drains.

## 2.3 CONTROLS

- A. The solenoid valve on the line from the compressor receiver to the hydropneumatic tank shall be controlled by the liquid level probes installed in the hydropneumatic tank. A hand-off-auto switch shall open the solenoid valve at the high water probe level and close the valve at the low water probe level.
- B. Solenoid valve shall be a 1" ASCO or Engineer approved equivalent valve for air service and shall open when energized.
- C. Liquid level probes shall be Warrick Controls HP-2 level direct mode (energize on high level) control kit and solenoid energized LED pilot light.

## PART 3 EXECUTION

### 3.1 FOUNDATION, ANCHORING, AND ENCLOSURE

- A. Concrete slab shall be constructed in accordance with Section 03 33 00 - Cast-in-Place Concrete (Site Work), and with the compressor manufacturer's seismic calculations.

- B. Anchoring shall be in conformance with compressor manufacturer's recommendations.
- C. A painted expanded metal enclosure shall be placed over the compressor and fastened to the concrete foundation.
- D. Level controls and hand-off-auto switch shall be installed in a weatherproof enclosure adjacent to the air compressor.

### 3.2 *AIR PIPING*

- A. Air piping shall be 2" galvanized steel and shall be sloped to drain condensate to the valve drain box as shown on the Plans.
- B. Isolation and drain valves shall be stainless steel ball valves for air service.
- C. Check valve shall be a bronze "Y" pattern valve with Buna-N seat.
- D. Contractor shall coordinate with hydropneumatic tank supplier to provide proper tank fitting for the liquid level probe installation.

### 3.3 *PROTECTIVE COATINGS*

- A. Exterior Surfaces:
  - 1. Paint finish to be suitable for outside installation, in accordance with Section 09 90 00 – Painting and Coating.
  - 2. Service Conditions: For use on exterior metal and piping subject to sunlight and weathering.

**END OF SECTION**

## **SECTION 46 33 44**

### **PERISTALTIC CHEMICAL FEED PUMPS**

#### **PART 1 GENERAL**

##### *1.1 WORK INCLUDED*

- A. This section includes peristaltic chemical metering pumps.

##### *1.2 RELATED WORK*

- A. Section 01 33 00 – Submittal Procedures
- B. Section 46 33 85 – Chemical Metering Skids and Accessories

##### *1.3 REFERENCES*

- A. ANSI/NSF 61 Drinking Water System Components
- B. National Electrical Code (NEC)
- C. National Electrical Manufacturers Association (NEMA)

##### *1.4 SUBMITTALS*

- A. Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit drawings showing general dimensions, installation requirements, materials of construction, connections, elevations, and operator interface.
- C. Submit electrical schematics indicating power requirements, control inputs, and telemetry outputs.
- D. Submit operational narrative describing in detail the operation of the chemical feed pumps.
- E. Submit documentation demonstrating certification to ANSI/NSF Standard 61.
- F. Submit certification that materials of construction are compatible with the fluid being pumped.
- G. Submit Operation and Maintenance Manuals in accordance with Section 01 33 00 prior to shipping pumps to the project site.

### 1.5 QUALITY ASSURANCE

- A. All components of the metering pumps in contact with the chemical being pumped shall be certified to comply with NSF/ANSI Standard 61 (Drinking Water System Components – Health Effects).
- B. The metering pump manufacturer shall be responsible for assuring that the materials in contact with the process chemical(s) are compatible with the chemical(s). If the manufacturer believes that specific materials required by this specification are not appropriate for the process chemical(s), then the manufacturer shall request a substitution prior to bid.

### 1.6 WARRANTY

- A. The metering pumps shall be warranted to be free of defects in material and workmanship for a period of 5 years from the date of installation.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. The peristaltic chemical metering pump shall be one of the following or equal
  - 1. Blue-White ProSeries
  - 2. Verder, Verderflex Series
  - 3. Watson Marlow Qdos

### 2.2 GENERAL

- A. Pump shall be a positive displacement, peristaltic type complete with pump head, self-contained variable speed drive, and flexible extruded tube.
- B. Pump shall be capable of 24-hour continuous duty at 45 degrees C ambient temperature, capable of running in either direction, and capable of running dry without damage.
- C. Pump shall be self priming with a suction lift of at least 30 feet of water.
- D. Pump shall use no check valves or diaphragms and shall require no dynamic seals in contact with the liquid. The process liquid shall be contained within the pump tubing and shall not directly contact any rotary or metallic components.
- E. Pump shall be designed for washdown exposure and compatible with the chemical being pumped.

### 2.3 PUMP HEAD

- A. Pump head shall incorporate a fixed track with a removable cover, an adjustable tube retainer mechanism, and a rotor assembly.
- B. Squeeze rollers with encapsulated ball bearings shall be directly coupled to a one-piece thermoplastic rotor. Four shall be provided.
- C. One roller shall at all times be fully engaged with the tubing providing complete compression to prevent back flow or siphoning. The tubing shall be in contact with the track through a minimum angle of 180 degrees and be held in place at the suction and discharge ends.
- D. Tubing shall be replaceable with no disassembly of the pump head.
- E. Cover shall be positively secured to the pump head and removable without the use of tools. Pump head cover shall seal against the pump head for complete leak containment.

### 2.4 TUBE ASSEMBLY

- A. Tubing shall be furnished by the pump manufacturer.
- B. Tube connections shall be constructed of PVDF or equally chemically resistant material.
- C. Manufacturer shall certify that the tube material is appropriate for the services indicated and will not invalidate the pump warranty. Any change in materials required to satisfy the Manufacturer's warranty terms shall be at no additional cost to the Owner.

### 2.5 DRIVE

- A. Drive shall be factory installed and totally enclosed in a NEMA 4X, (IP66) wash-down enclosure. Capable of operating on 110VAC, 60 Hz single phase.
- B. Pump drive shall be close coupled and self-aligning, requiring no flexible couplings.
- C. Drive speed shall be infinitely variable.
- D. Motor shall be a reversible, brushless DC gear motor rated for continuous duty. Motor shall be equipped with overload protection and limited to a maximum speed of 130 rpm.

### 2.6 CONTROLS

- A. All control circuitry shall be integral to the pump and capable of adjusting the pump motor speed from 0.01% to 100.00% in 0.01% increments less than 1% motor

speed and in 0.1% increments greater than 1% motor speed (10,000:1 turndown ratio).

- B. Provide for remote stop/start signal via 24V logic or non-powered contact closure loop.
- C. Provide for manual/auto and local/remote control.
- D. The pump output shall be capable of being remotely controlled via 4-20mA analog input with input signal trimmable and speed scalable over any part of the speed range.
- E. The pump output shall be capable of being remotely controlled via pulse triggered batching. The pump shall accept a TTL/Cmos digital pulse type input and a contact closure type pulse input.
- F. Provide at least two output relay contacts, NO or NC, software configurable for running/stopped status; forward/reverse status; auto/manual status; general alarm status; and leak detected status.
- G. Provide 4 – 20mA speed output signal.
- H. Pump shall automatically restart in the event of a power outage.

## 2.7 USER INTERFACE

- A. Provide a graphical backlit LCD display for menu driven configuration settings, pump speed, run status, flow rate, service alerts, tube failure detection system and flow verification system (if required) alarms status.
- B. Provide keypad and/or click wheel for start, stop, speed, forward/reverse, prime, and programming.
- C. Interface shall include a lock function designed to protect against unauthorized settings changes.
- D. A built-in counter shall provide a running total of accumulated revolutions.

## 2.8 LEAK DETECTION

- A. Pump shall include a leak sensor in the pump head designed to detect failure of the tube or leakage at the tube connections.
- B. Leak detection shall initiate a remote alarm and disable the pump.

## 2.9 FLOW VERIFICATION

- A. Where indicated in Part 3 provide a flow verification sensor to verify chemical injection.



- B. Flow verification sensor shall be paddlewheel type sensor generating a digital pulse signal and shall be active only when the pump is running.
- C. Sensor operating range shall be compatible with the range of design feed rates described in Part 3.

**2.10 ACCESSORIES AND SPARE PARTS**

- A. Pumps shall include all required electrical interface cables with pump-specific plug at one end and exposed wire at the other end for connection by the Contractor.
- B. Furnish each pump with a spare replacement tube assembly.

**PART 3 EXECUTION**

**3.1 MANUFACTURER'S FIELD SERVICES**

- A. Provide Manufacturer's services at the jobsite for one day to advise during start-up, testing, and adjustment of the equipment; and to instruct the Owner in the proper operation of the equipment.
- B. Provide Manufacturer's services at the jobsite for one day during startup after the treatment plant has been placed in operation. The purpose of this second visit will be to fine-tune the settings on the pumps and further instruct the Owner in the proper operation of the equipment.

**3.2 FIELD OR SITE QUALITY CONTROL**

- A. Operate each pump for two hours over the full range of operating conditions using only water before supplying the pump with chemical.

**3.3 SCHEDULE**

Chemical	0.8% - 13% Sodium Hypochlorite
Tag Number	CSA 30: CMP-101 CMP-102 CSA 32: CMP-103, CMP-104
Number of Pumps	CSA 30: 2 CSA 32: 2
Location	Outdoors, in enclosure
Listed Manufacturer's Model	Flex-Pro M-3
Design Pumping Pressure	0.009 gph

County of Fresno  
Westside Groundwater Project  
CSA 30 and 32 Water Treatment

Minimum Pumping Rate	0.002 gph
Maximum Pumping Rate	2.0 gph
Maximum Pumping Pressure	75 psi
Ambient Temperature	20 - 115°F

**END OF SECTION**

PERISTALTIC CHEMICAL FEED PUMPS  
46 33 44-6

## **SECTION 46 33 85**

### **CHEMICAL METERING SKIDS AND ACCESSORIES**

#### **PART 1 GENERAL**

##### **1.1 WORK INCLUDED**

- A. This section includes complete factory pre-assembled chemical metering pump skids and accessories. Skids shall include metering pump(s), calibration column(s), back pressure valve(s), pressure relief valve(s), piping, fittings, isolation valves, and electrical panels required to provide a complete system.

##### **1.2 RELATED WORK**

- A. Section 40 07 75 – Equipment, Piping, Duct, and Valve Identification
- B. Section 46 33 43 – Motor Operated Diaphragm Chemical Feed Pumps

##### **1.3 REFERENCES**

- A. ANSI / NSF – 61
- B. National Electrical Code (NEC)
- C. National Electrical Manufacturers Association (NEMA)

##### **1.4 SUBMITTALS**

- A. Submittals shall be in accordance with the General and Special Conditions.
- B. Submit product datasheets for individual accessories.
- C. Submit drawings showing general dimensions, installation requirements, materials of construction, connections, mounting interfaces, and elevations
- D. Submit electrical schematics indicating power requirements, control inputs, and telemetry outputs
- E. Submit documentation demonstrating certification of skid or all individual components in contact with the process chemicals to NSF/ANSI-61.
- F. Submit certification that materials of construction are compatible with the fluid being pumped.
- G. Submit procedure for factory pressure testing the skid. Submit factory test results before skids are shipped to the project site.
- H. Submit Operation and Maintenance Manuals prior to shipping pumps to the project site.

## 1.5 QUALITY ASSURANCE

- A. All components in contact with the chemical being pumped shall be certified to comply with NSF/ANSI Standard 61 (Drinking Water System Components – Health Effects).
- B. Each chemical metering skid shall be subjected to a non-witnessed factory performance test using water as the test fluid. The factory performance test shall be designed to accomplish the following:
  - 1. Pressurize the metering pump and skid piping to the design operating pressure for a minimum of two hours to ensure there are no leaks. Repair and replace any leaking joints and retest.
  - 2. Confirm that the skid responds to all metering pump control signals and generates and transmits all specified alarm signals.
  - 3. Pre-adjustment of skid accessories (e.g. pressure relief valves, backpressure valves)

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. The chemical metering skid shall be fabricated and assembled by the metering pump manufacturer or a company specifically authorized in writing to do so by the metering pump manufacturer.
- B. The pumps for each chemical system shall be completely assembled, mounted, calibrated, tested, and delivered to the site on a single skid. The pump skid manufacturer shall be responsible for providing all equipment, valves, and piping within the skid boundary. The Contractor shall be required to mount the skid to the building and make connections only for inlet piping, outlet piping, and power and control cabling to the skid electrical junction box. Anchor bolts shall be furnished and installed by the Contractor based on the skid manufacturer's recommendations.

### 2.2 CHEMICAL COMPATIBILITY

- A. All components of the skid in contact with the process chemical, designed to contain spillage of the process chemical, or likely to be splashed by the process chemical (including fasteners) shall be suitable for continuous exposure to the chemical being pumped.

### 2.3 CHEMICAL METERING PUMP

- A. Refer to Specification 46 33 43 for chemical metering pump requirements.

## 2.4 SKID CONSTRUCTION

- A. Pumps and appurtenances shall be positioned on the skid so that maintenance personnel will have convenient access to the pump. No accessories shall be located in such a way as to require their removal for removal of the pump.
- B. Skids shall be constructed of high density polyethylene sheets, PVC sheets, polypropylene or fiberglass reinforced plastic (FRP) of minimum 1/2" thickness and gusseted to provide adequate stiffness and support to equipment.
- C. The skid shall include two notched openings suitable for moving the skid with a forklift and shall include lifting lugs for overhead lifting.
- D. The bottom of the skid shall include a drip-rim of at least 1-inch in height with a 1/2-inch minimum threaded hole with a plug in the bottom suitable for attachment of drain piping.
- E. Piping and accessories shall be mounted to the skid using chemical resistant clips and fasteners. Attachment of clips or accessories using adhesive will not be accepted.
- F. Provide means of mounting skid to support pad using chemical resistant clips and anchors.

## 2.5 CALIBRATION CYLINDER

- A. Install a clear PVC calibration cylinder in the suction line. Calibration cylinder shall include easy to read graduations in mLs and gph. Cylinder shall have a sealed top with an overflow connection allowing cylinder to be vented back to the chemical storage tank.
- B. The calibration cylinder shall be piped so that all pumps on the skid can utilize it. Duplex skids, when provided, can utilize a common column for calibration.
- C. Calibration cylinder capacity shall be appropriate to allow for 30-second draw-down at the maximum metering pump capacity.

## 2.6 PULSATION DAMPENERS

- A. Each pump shall be equipped with a single-port pulsation dampener equipped with a pressure gauge.
- B. Pulsation dampeners shall be chargeable using a Schrader valve.
- C. Pulsation dampeners shall be designed to limit the pulsation amplitude to 2 psig or less.
- D. The pulsation dampener body and bladder shall be constructed of CPVC and Viton respectively unless otherwise noted. Other materials may be substituted only if CPVC and/or Viton are incompatible with the liquid being pumped.

## 2.7 PRESSURE RELIEF VALVE

- A. Each pump shall be equipped with a pressure relief valve designed to protect the chemical feed system from over-pressure damage. The relief port shall be plumbed to the suction side of the metering pump.
- B. The pressure relief valve shall be field adjustable between 10 – 150 psi via an adjustment screw.
- C. The valve shall be installed as close to the pump as possible, upstream from the back-pressure valve, pressure gauge and pulsation dampener.
- D. The valve body shall be constructed of CPVC. The diaphragm shall be constructed of Teflon.

## 2.8 BACKPRESSURE VALVE

- A. Each pump shall be equipped with a back-pressure valve designed to provide a continuous back pressure to the pump and to prevent siphoning of chemical through the system.
- B. The back-pressure valve shall be field adjustable between 0 – 150 psi via an adjustment screw.
- C. The valve shall be installed as close to the pump skid discharge connection as possible, downstream from the pressure relief valve, pressure gauge and pulsation dampener.
- D. The valve body shall be constructed of CPVC. The diaphragm shall be constructed of Viton or EPDM as appropriate for compatibility with the chemical being pumped. Diaphragms for sodium hydroxide service shall be EPDM.

## 2.9 PIPING, VALVES, AND OTHER APPURTENANCES

- A. Piping shall be Schedule 80 PVC, CPVC, or PVDF as required for compatibility with the service chemicals and pressures. Piping size shall be appropriate for the maximum specified chemical dosage rate, but in no case shall be less than ½ inch.
- B. Isolation ball valves shall be installed at the skid suction connection, skid discharge connection, calibration cylinder, discharge bleed connection, and as additionally shown on the drawings. Valves shall be of the true union type. Ball valves for sodium hypochlorite service shall be vented.
- C. Install a pressure gauge on the discharge side of the pump. The gauge shall be 2-1/2 inch in diameter and have a scale high enough for the maximum pressure attainable by the pump. Gauges shall be liquid filled and include a chemically compatible seal isolating the gauge from the chemical.
- D. Install a Y-type strainer on the suction line of the pump to prevent debris from entering the pump.

- E. The metering pumps, valves, and appurtenances shall be installed using unions so that they can be removed without disturbing the remainder of the skid.

#### **2.10 CONTROL PANEL / ELECTRICAL JUNCTION BOX**

- A. All skid power and control wiring shall terminate at an FRP NEMA 4X rated terminal box.

#### **2.11 SERVICE CONDITIONS**

- A. Service conditions shall be as described in Specification 46 33 43.

### **PART 3 EXECUTION**

#### **3.1 ASSEMBLY**

- A. Skids shall be fully assembled in the factory and shall only require mounting to the building or slab; inlet connection; outlet connection; and wiring to the skid junction box in the field.

#### **3.2 CONNECTION LOCATIONS**

- A. Process connection locations shall be as shown on the plans.
- B. Where specific connection locations are not shown on the plans, connection locations shall be defined by the Engineer during the submittal process.

#### **3.3 TESTING**

- A. Assembled skids shall be pressure tested in the factory as described in Part 1.
- B. Following installation operate each skid for two hours over the full range of operating conditions using water before supplying the pump with chemical.
- C. Verify factory pressure relief valve and backpressure valves settings prior to supplying the pump with chemical.

#### **3.4 MANUFACTURER'S FIELD SERVICES**

- A. Manufacturer's field services shall be as specified in Section 46 33 43.

**END SECTION**

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# **Federal Requirements**

## FEDERAL REQUIREMENTS FOR FEDERAL-AID CONSTRUCTION PROJECTS

### General

The work will be financed in whole or in part with Federal funds, and therefore all of the Federal statutes, rules, regulations, and provisions applicable to work financed in whole or in part with Federal funds will apply.

In addition to the provisions in the Agreement, the Contractor shall comply with the following:

### Performance Of Previous Contracts

The bidder shall execute the "Certification with Regard to the Performance of Previous Contracts or Subcontracts Subject to the Equal Opportunity Clause and the Filing of Required Reports" located in the proposal. No request for subletting or assigning any portion of the contract in excess of \$10,000 will be considered under the provisions of Section VII of the required contract provisions unless such request is accompanied by the Certification referred to above, executed by the proposed subcontractor.

### Non-Collusion Provision

The provisions in this section are applicable to all contracts except contracts for Federal Aid Secondary projects. Title 23, United States Code, Section 112, requires as a condition precedent to approval by the Federal Highway Administrator of the contract for this work that each bidder file a sworn statement executed by, or on behalf of, the person, firm, association, or corporation to whom such contract is to be awarded, certifying that such person, firm, association, or corporation has not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding in connection with the submitted bid. A form to make the non-collusion affidavit statement required by Section 112 as a certification under penalty of perjury rather than as a sworn statement as permitted by 28, USC, Sec. 1746, is included in the proposal.

### Executive Order N-6-22

Under Executive Order N-6-22 as a contractor, subcontractor, or grantee, compliance with the economic sanctions imposed in response to Russia's actions in Ukraine is required, including with respect to, but not limited to, the federal executive orders identified in the EO and the sanctions identified on the U.S. Department of the Treasury website (<https://home.treasury.gov/policy-issues/financial-sanctions/sanctions-programs-and-country-information/ukraine-russia-related-sanctions>). Failure to comply may result in the termination of contracts or grants, as applicable.

### Specially Designated Nationals and Blocked Persons List (SDN)

<https://home.treasury.gov/policy-issues/financial-sanctions/specially-designated-nationals-and-blocked-persons-list-sdn-human-readable-lists>

### Prohibition of Certain Telecommunications and Video Surveillance Equipment and Services

In response to significant national security concerns, the agency shall check the prohibited vendor list before making any telecommunications and video surveillance purchase because recipients and subrecipients of federal funds are prohibited from obligating or expending loan or grant funds to:

- Procure or obtain;
- Extend or renew a contract to procure or obtain; or
- Enter into a contract (or extend or renew a contract) to procure or obtain equipment, services, or systems that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system.

The prohibited vendors (and their subsidiaries or affiliates) are:

- Huawei Technologies Company;
- ZTE Corporation;

- Hytera Communications Corporation;
- Hangzhou Hikvision Digital Technology Company;
- Dahua Technology Company; and
- Subsidiaries or affiliates of the above-mentioned companies.

In implementing the prohibition, the agency administering loan, grant, or subsidy programs shall prioritize available funding and technical support to assist affected businesses, institutions and organizations as is reasonably necessary for those affected entities to transition from covered communications equipment and services, to procure replacement equipment and services, and to ensure that communications service to users and customers is sustained.

## Female And Minority Goals

To comply with Section II, "Nondiscrimination," of "Required Contract Provisions Federal-Aid Construction Contracts," the following are for female and minority utilization goals for Federal-aid construction contracts and subcontracts that exceed \$10,000:

The nationwide goal for female utilization is 6.9 percent.

The goals for minority utilization [45 Fed Reg 65984 (10/3/1980)] are as follows:

### Minority Utilization Goals

	Economic Area	Goal (Percent)
174	Redding CA: Non-SMSA (Standard Metropolitan Statistical Area) Counties: CA Lassen; CA Modoc; CA Plumas; CA Shasta; CA Siskiyou; CA Tehama	6.8
175	Eureka, CA Non-SMSA Counties: CA Del Norte; CA Humboldt; CA Trinity	6.6
174	Redding CA: Non-SMSA (Standard Metropolitan Statistical Area) Counties: CA Lassen; CA Modoc; CA Plumas; CA Shasta; CA Siskiyou; CA Tehama	6.8
175	Eureka, CA Non-SMSA Counties: CA Del Norte; CA Humboldt; CA Trinity	6.6
176	San Francisco-Oakland-San Jose, CA: SMSA Counties: 7120 Salinas-Seaside-Monterey, CA	28.9
	CA Monterey	25.6
	7360 San Francisco-Oakland	19.6
	CA Alameda; CA Contra Costa; CA Marin; CA San Francisco; CA San Mateo	14.9
	7400 San Jose, CA	9.1
	CA Santa Clara, CA 7485 Santa Cruz, CA	17.1
	CA Santa Cruz	23.2
177	7500 Santa Rosa	16.1
	CA Sonoma	14.3
177	8720 Vallejo-Fairfield-Napa, CA	
	CA Napa; CA Solano	
	Non-SMSA Counties: CA Lake; CA Mendocino; CA San Benito	
	SMSA Counties: 6920 Sacramento, CA	
	CA Placer; CA Sacramento; CA Yolo	
Non-SMSA Counties CA Butte; CA Colusa; CA El Dorado; CA Glenn; CA Nevada; CA Sierra; CA Sutter; CA Yuba		

178	Stockton-Modesto, CA:	
	SMSA Counties:	12.3
	5170 Modesto, CA CA Stanislaus 8120 Stockton, CA CA San Joaquin	24.3
	Non-SMSA Counties	19.8
	CA Alpine; CA Amador; CA Calaveras; CA Mariposa; CA Merced; CA Tuolumne	
179	Fresno-Bakersfield, CA	
	SMSA Counties:	19.1
	0680 Bakersfield, CA CA Kern	26.1
	2840 Fresno, CA CA Fresno	23.6
	Non-SMSA Counties:	
	CA Kings; CA Madera; CA Tulare	
180	Los Angeles, CA:	
	SMSA Counties:	11.9
	0360 Anaheim-Santa Ana-Garden Grove, CA CA Orange	28.3
	4480 Los Angeles-Long Beach, CA CA Los Angeles	21.5
	6000 Oxnard-Simi Valley-Ventura, CA CA Ventura	19.0
	6780 Riverside-San Bernardino-Ontario, CA CA Riverside; CA San Bernardino	19.7
	7480 Santa Barbara-Santa Maria-Lompoc, CA CA Santa Barbara	24.6
	Non-SMSA Counties	
CA Inyo; CA Mono; CA San Luis Obispo		
181	San Diego, CA:	
	SMSA Counties	16.9
	7320 San Diego, CA CA San Diego	
	Non-SMSA Counties	18.2
	CA Imperial	

<https://www.dol.gov/sites/dolgov/files/ofccp/ParticipationGoals.pdf>

**Federal Wage Rates**

<https://sam.gov/content/wage-determinations>

## Davis-Bacon Requirements for DWSRF Projects

For purposes of this Exhibit only, “subrecipient” or “sub recipient” means the Recipient as defined in this Agreement.

For purposes of this Exhibit only, “recipient” or “State recipient” means the State Water Board.

### **II. Requirements Under the Safe Drinking Water Act, Section 1452(a)(5) For Sub recipients That Are Not Governmental Entities:**

If a sub recipient has questions regarding when DB applies, obtaining the correct DB wage determinations, DB provisions, or compliance monitoring, it may contact the State Water Board at [DavisBacon@waterboards.ca.gov](mailto:DavisBacon@waterboards.ca.gov) or phone (916) 327-7323. The recipient or sub recipient may also obtain additional guidance from DOL’s web site at <http://www.dol.gov/whd/>.

**Under these terms and conditions, the sub recipient must submit its proposed DB wage determinations to the State recipient for approval prior to including the wage determination in any solicitation, contract task orders, work assignments, or similar instruments to existing contractors.**

#### **1. Applicability of the Davis- Bacon (DB) prevailing wage requirements.**

Under the Safe Drinking Water Act, Section 1452(a)(5), DB prevailing wage requirements apply to the construction, alteration, and repair of treatment works carried out in whole or in part with assistance made available by a State water pollution control revolving fund and to any construction project carried out in whole or in part by assistance made available by a drinking water treatment revolving loan fund. If a sub recipient encounters a unique situation at a site that presents uncertainties regarding DB applicability, the sub recipient must discuss the situation with the recipient State before authorizing work on that site.

#### **2. Obtaining Wage Determinations.**

(a) Sub recipients must obtain proposed wage determinations for specific localities at [beta.sam.gov](http://beta.sam.gov). After the Sub recipient obtains its proposed wage determination, it must submit the wage determination to the appropriate State contact for approval prior to inserting the wage determination into a solicitation, contract or issuing task orders, work assignments or similar instruments to existing contractors (ordering instruments unless subsequently directed otherwise by the State recipient Award Official.)

(b) Sub recipients shall obtain the wage determination for the locality in which a covered activity subject to DB will take place prior to issuing requests for bids, proposals, quotes or other methods for soliciting contracts (solicitation) for activities subject to DB. These wage determinations shall be incorporated into solicitations and any subsequent

contracts. Prime contracts must contain a provision requiring that subcontractors follow the wage determination incorporated into the prime contract.

- (i) While the solicitation remains open, the sub recipient shall monitor [beta.sam.gov](https://beta.sam.gov) on a weekly basis to ensure that the wage determination contained in the solicitation remains current. The sub recipients shall amend the solicitation if DOL issues a modification more than 10 days prior to the closing date (i.e. bid opening) for the solicitation. If DOL modifies or supersedes the applicable wage determination less than 10 days prior to the closing date, the sub recipients may request a finding from the State recipient that there is not a reasonable time to notify interested contractors of the modification of the wage determination. The State recipient will provide a report of its findings to the sub recipient.
- (ii) If the sub recipient does not award the contract within 90 days of the closure of the solicitation, any modifications or supersedes DOL makes to the wage determination contained in the solicitation shall be effective unless the State recipient, at the request of the sub recipient, obtains an extension of the 90 day period from DOL pursuant to 29 CFR 1.6(c)(3)(iv). The sub recipient shall monitor [beta.sam.gov](https://beta.sam.gov) on a weekly basis if it does not award the contract within 90 days of closure of the solicitation to ensure that wage determinations contained in the solicitation remain current.

(c) If the sub recipient carries out activity subject to DB by issuing a task order, work assignment or similar instrument to an existing contractor (ordering instrument) rather than by publishing a solicitation, the sub recipient shall insert the appropriate DOL wage determination from [beta.sam.gov](https://beta.sam.gov) into the ordering instrument.

(d) Sub recipients shall review all subcontracts subject to DB entered into by prime contractors to verify that the prime contractor has required its subcontractors to include the applicable wage determinations.

(e) As provided in 29 CFR 1.6(f), DOL may issue a revised wage determination applicable to a sub recipient's contract after the award of a contract or the issuance of an ordering instrument if DOL determines that the sub recipient has failed to incorporate a wage determination or has used a wage determination that clearly does not apply to the contract or ordering instrument. If this occurs, the sub recipient shall either terminate the contract or ordering instrument and issue a revised solicitation or ordering instrument or incorporate DOL's wage determination retroactive to the beginning of the contract or ordering instrument by change order. The sub recipient's contractor must be compensated for any increases in wages resulting from the use of DOL's revised wage determination.

### 3. Contract and Subcontract provisions.

(a) The Recipient shall insure that the sub recipient(s) shall insert in full in any contract in excess of \$2,000 which is entered into for the actual construction, alteration and/or repair, including painting and decorating, of a treatment work under the CWSRF or a construction project carried out in whole or in part with assistance made available by the DWSRF, and which is subject to the labor standards provisions of any of the acts listed in § 5.1 or the Safe Drinking Water Act, Section 1452(a)(5), the following clauses:

#### (1) Minimum wages.

(i) All laborers and mechanics employed or working upon the site of the work, will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in § 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

Sub recipients may obtain wage determinations from the U.S. Department of Labor's web site, [beta.sam.gov](http://beta.sam.gov).

(ii)(A) The sub recipient(s), on behalf of EPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and



which is to be employed under the contract shall be classified in conformance with the wage determination. The State award official shall approve a request for an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the sub recipient(s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), documentation of the action taken and the request, including the local wage determination shall be sent by the sub recipient(s) to the State award official. The State award official will transmit the report, to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210 and to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification request within 30 days of receipt and so advise the State award official or will notify the State award official within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the and the sub recipient(s) do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the award official shall refer the request, and the local wage determination, including the views of all interested parties and the recommendation of the State award official, to the Administrator for determination. The request shall be sent to the EPA Regional Coordinator concurrently. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt of the request and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii)(B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly

rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2)Withholding. The sub recipient(s) shall upon written request of the EPA Award Official or an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3)Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the

apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly, for each week in which any contract work is performed, a copy of all payrolls to the sub recipient, that is, the entity that receives the sub-grant or loan from the State capitalization grant recipient. Such documentation shall be available on request of the State recipient or EPA. As to each payroll copy received, the sub recipient shall provide written confirmation in a form satisfactory to the State indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week. The payrolls shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on the weekly payrolls. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <http://www.dol.gov/whd/forms/wh347instr.htm> or its successor site.

The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the sub recipient(s) for transmission to the State or EPA if requested by EPA, the State, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the sub recipient(s).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under § 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under § 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the State, EPA or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency or State may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and trainees--

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is

registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractors registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination.

Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment

opportunity requirements of Executive Order 11246, as amended and 29 CFR part 30.

(5) Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the EPA determines may be appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) Contract termination: debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and Sub recipient(s), State, EPA, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility.

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

#### 4. Contract Provision for Contracts in Excess of \$100,000.

(a) Contract Work Hours and Safety Standards Act. The sub recipient shall insert the following clauses set forth in paragraphs (a)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by Item 3, above or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (b)(1) of this section the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (b)(1) of this section, in the sum of \$25 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages. The sub recipient shall upon the request of the EPA Award Official or an authorized representative of the Department of Labor, withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (a)(2) of this section.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (a)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or

lower tier subcontractor with the clauses set forth in paragraphs (a)(1) through (4) of this section.

(b) In addition to the clauses contained in Item 3, above, in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 CFR 5.1, the Sub recipient shall insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Sub recipient shall insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the (write the name of agency) and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

## **5. Compliance Verification**

(a) The sub recipient shall periodically interview a sufficient number of employees entitled to DB prevailing wages (covered employees) to verify that contractors or subcontractors are paying the appropriate wage rates. As provided in 29 CFR 5.6(a)(3), all interviews must be conducted in confidence. The sub recipient must use Standard Form 1445 (SF 1445) or equivalent documentation to memorialize the interviews. Copies of the SF 1445 are available from EPA on request.

(b) The sub recipient shall establish and follow an interview schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. Sub recipients must conduct more frequent interviews if the initial interviews or other information indicated that there is a risk that the contractor or subcontractor is not complying with DB. Sub recipients shall immediately conduct interviews in response to an alleged violation of the prevailing wage requirements. All interviews shall be conducted in confidence."

(c) The sub recipient shall periodically conduct spot checks of a representative sample of weekly payroll data to verify that contractors or subcontractors are paying the appropriate wage rates. The sub recipient shall establish and follow a spot check schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, if practicable the sub recipient should spot check payroll data within two weeks of each contractor or subcontractor's submission of its initial payroll data and two weeks prior to the completion date the contract or subcontract. Sub recipients must conduct more frequent spot checks if the initial spot check or other information indicates that there is a risk that the contractor or subcontractor is not complying with



DB. In addition, during the examinations the sub recipient shall verify evidence of fringe benefit plans and payments there under by contractors and subcontractors who claim credit for fringe benefit contributions.

(d) The sub recipient shall periodically review contractors and subcontractors use of apprentices and trainees to verify registration and certification with respect to apprenticeship and training programs approved by either the U.S Department of Labor or a state, as appropriate, and that contractors and subcontractors are not using disproportionate numbers of, laborers, trainees and apprentices. These reviews shall be conducted in accordance with the schedules for spot checks and interviews described in Item 5(b) and (c) above.

(e) Sub recipients must immediately report potential violations of the DB prevailing wage requirements to the EPA DB contact listed above and to the appropriate DOL Wage and Hour District Office listed at

<https://www.dol.gov/agencies/whd/contact/local-offices>.



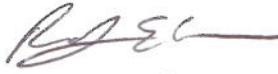
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
WASHINGTON, D.C. 20460


MAR 20 2014

OFFICE OF WATER

**MEMORANDUM**

SUBJECT: Implementation of American Iron and Steel provisions of P.L. 113-76,  
Consolidated Appropriations Act, 2014

FROM: For Andrew D. Sawyers, Director   
Office of Wastewater Management (4201M)

Peter C. Grevatt, Director   
Office of Ground Water and Drinking Water (4601M)

TO: Water Management Division Directors  
Regions I - X

P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an “American Iron and Steel (AIS)” requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works if the project is funded through an assistance agreement executed beginning January 17, 2014 (enactment of the Act), through the end of Federal Fiscal Year 2014.

Section 436 also sets forth certain circumstances under which EPA may waive the AIS requirement. Furthermore, the Act specifically exempts projects where engineering plans and specifications were approved by a State agency prior to January 17, 2014.

The approach described below explains how EPA will implement the AIS requirement. The first section is in the form of questions and answers that address the types of projects that must comply with the AIS requirement, the types of products covered by the AIS requirement, and compliance. The second section is a step-by-step process for requesting waivers and the circumstances under which waivers may be granted.

## Implementation

The Act states:

Sec. 436. (a)(1) None of the funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) or made available by a drinking water treatment revolving loan fund as authorized by section 1452 of the Safe Drinking Water Act (42 U.S.C. 300j-12) shall be used for a project for the construction, alteration, maintenance, or repair of a public water system or treatment works unless all of the iron and steel products used in the project are produced in the United States.

(2) In this section, the term “iron and steel products” means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.

(b) Subsection (a) shall not apply in any case or category of cases in which the Administrator of the Environmental Protection Agency (in this section referred to as the “Administrator”) finds that—

(1) applying subsection (a) would be inconsistent with the public interest;

(2) iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or

(3) inclusion of iron and steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

(c) If the Administrator receives a request for a waiver under this section, the Administrator shall make available to the public on an informal basis a copy of the request and information available to the Administrator concerning the request, and shall allow for informal public input on the request for at least 15 days prior to making a finding based on the request. The Administrator shall make the request and accompanying information available by electronic means, including on the official public Internet Web site of the Environmental Protection Agency.

(d) This section shall be applied in a manner consistent with United States obligations under international agreements.

(e) The Administrator may retain up to 0.25 percent of the funds appropriated in this Act for the Clean and Drinking Water State Revolving Funds for carrying out

the provisions described in subsection (a)(1) for management and oversight of the requirements of this section.

(f) This section does not apply with respect to a project if a State agency approves the engineering plans and specifications for the project, in that agency's capacity to approve such plans and specifications prior to a project requesting bids, prior to the date of the enactment of this Act.

The following questions and answers provide guidance for implementing and complying with the AIS requirements:

### **Project Coverage**

#### **1) What classes of projects are covered by the AIS requirement?**

All treatment works projects funded by a CWSRF assistance agreement, and all public water system projects funded by a DWSRF assistance agreement, from the date of enactment through the end of Federal Fiscal Year 2014, are covered. The AIS requirements apply to the entirety of the project, no matter when construction begins or ends. Additionally, the AIS requirements apply to all parts of the project, no matter the source of funding.

#### **2) Does the AIS requirement apply to nonpoint source projects or national estuary projects?**

No. Congress did not include an AIS requirement for nonpoint source and national estuary projects unless the project can also be classified as a 'treatment works' as defined by section 212 of the Clean Water Act.

#### **3) Are any projects for the construction, alteration, maintenance, or repair of a public water system or treatment works excluded from the AIS requirement?**

Any project, whether a treatment works project or a public water system project, for which engineering plans and specifications were approved by the responsible state agency prior to January 17, 2014, is excluded from the AIS requirements.

#### **4) What if the project does not have approved engineering plans and specifications but has signed an assistance agreement with a CWSRF or DWSRF program prior to January 17, 2014?**

The AIS requirements do not apply to any project for which an assistance agreement was signed prior to January 17, 2014.

**5) What if the project does not have approved engineering plans and specifications, but bids were advertised prior to January 17, 2014 and an assistance agreement was signed after January 17, 2014?**

If the project does not require approved engineering plans and specifications, the bid advertisement date will count in lieu of the approval date for purposes of the exemption in section 436(f).

**6) What if the assistance agreement that was signed prior to January 17, 2014, only funded a part of the overall project, where the remainder of the project will be funded later with another SRF loan?**

If the original assistance agreement funded any construction of the project, the date of the original assistance agreement counts for purposes of the exemption. If the original assistance agreement was only for planning and design, the date of that assistance agreement will count for purposes of the exemption only if there is a written commitment or expectation on the part of the assistance recipient to fund the remainder of the project with SRF funds.

**7) What if the assistance agreement that was signed prior to January 17, 2014, funded the first phase of a multi-phase project, where the remaining phases will be funded by SRF assistance in the future?**

In such a case, the phases of the project will be considered a single project if all construction necessary to complete the building or work, regardless of the number of contracts or assistance agreements involved, are closely related in purpose, time and place. However, there are many situations in which major construction activities are clearly undertaken in phases that are distinct in purpose, time, or place. In the case of distinct phases, projects with engineering plans and specifications approval or assistance agreements signed prior to January 17, 2014 would be excluded from AIS requirements while those approved/signed on January 17, 2014, or later would be covered by the AIS requirements.

**8) What if a project has split funding from a non-SRF source?**

Many States intend to fund projects with “split” funding, from the SRF program and from State or other programs. Based on the Act language in section 436, which requires that American iron and steel products be used in any project for the construction, alteration, maintenance, or repair of a public water system or treatment works receiving SRF funding between and including January 17, 2014 and September 30, 2014, any project that is funded in whole or in part with such funds must comply with the AIS requirement. A “project” consists of all construction necessary to complete the building or work regardless of the number of contracts or assistance agreements involved so long as all contracts and assistance agreements awarded are closely related in purpose, time and place. This precludes the intentional splitting of SRF projects into separate and smaller contracts or assistance agreements to avoid AIS coverage on some portion of a larger

project, particularly where the activities are integrally and proximately related to the whole. However, there are many situations in which major construction activities are clearly undertaken in separate phases that are distinct in purpose, time, or place, in which case, separate contracts or assistance agreement for SRF and State or other funding would carry separate requirements.

**9) What about refinancing?**

If a project began construction, financed from a non-SRF source, prior to January 17, 2014, but is refinanced through an SRF assistance agreement executed on or after January 17, 2014 and prior to October 1, 2014, AIS requirements will apply to all construction that occurs on or after January 17, 2014, through completion of construction, unless, as is likely, engineering plans and specifications were approved by a responsible state agency prior to January 17, 2014. There is no retroactive application of the AIS requirements where a refinancing occurs for a project that has completed construction prior to January 17, 2014.

**10) Do the AIS requirements apply to any other EPA programs, besides the SRF program, such as the Tribal Set-aside grants or grants to the Territories and DC?**

No, the AIS requirement only applies to funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) or made available by a drinking water treatment revolving loan fund as authorized by section 1452 of the Safe Drinking Water Act (42 U.S.C. 300j-12)

**Covered Iron and Steel Products**

**11) What is an iron or steel product?**

For purposes of the CWSRF and DWSRF projects that must comply with the AIS requirement, an iron or steel product is one of the following made primarily of iron or steel that is permanently incorporated into the public water system or treatment works:

- Lined or unlined pipes or fittings;
- Manhole Covers;
- Municipal Castings (defined in more detail below);
- Hydrants;
- Tanks;
- Flanges;
- Pipe clamps and restraints;
- Valves;
- Structural steel (defined in more detail below);
- Reinforced precast concrete; and
- Construction materials (defined in more detail below).

**12) What does the term ‘primarily iron or steel’ mean?**

‘Primarily iron or steel’ places constraints on the list of products above. For one of the listed products to be considered subject to the AIS requirements, it must be made of greater than 50% iron or steel, measured by cost. The cost should be based on the material costs.

**13) Can you provide an example of how to perform a cost determination?**

For example, the iron portion of a fire hydrant would likely be the bonnet, body and shoe, and the cost then would include the pouring and casting to create those components. The other material costs would include non-iron and steel internal workings of the fire hydrant (i.e., stem, coupling, valve, seals, etc). However, the assembly of the internal workings into the hydrant body would not be included in this cost calculation. If one of the listed products is not made primarily of iron or steel, United States (US) provenance is not required. An exception to this definition is reinforced precast concrete, which is addressed in a later question.

**14) If a product is composed of more than 50% iron or steel, but is not listed in the above list of items, must the item be produced in the US? Alternatively, must the iron or steel in such a product be produced in the US?**

The answer to both question is no. Only items on the above list must be produced in the US. Additionally, the iron or steel in a non-listed item can be sourced from outside the US.

**15) What is the definition of steel?**

Steel means an alloy that includes at least 50 percent iron, between .02 and 2 percent carbon, and may include other elements. Metallic elements such as chromium, nickel, molybdenum, manganese, and silicon may be added during the melting of steel for the purpose of enhancing properties such as corrosion resistance, hardness, or strength. The definition of steel covers carbon steel, alloy steel, stainless steel, tool steel and other specialty steels.

**16) What does ‘produced in the United States’ mean?**

Production in the United States of the iron or steel products used in the project requires that all manufacturing processes, including application of coatings, must take place in the United States, with the exception of metallurgical processes involving refinement of steel additives. All manufacturing processes includes processes such as melting, refining, forming, rolling, drawing, finishing, fabricating and coating. Further, if a domestic iron and steel product is taken out of the US for any part of the manufacturing process, it becomes foreign source material. However, raw materials such as iron ore, limestone and iron and steel scrap are not covered by the AIS requirement, and the

material(s), if any, being applied as a coating are similarly not covered. Non-iron or steel components of an iron and steel product may come from non-US sources. For example, for products such as valves and hydrants, the individual non-iron and steel components do not have to be of domestic origin.

**17) Are the raw materials used in the production of iron or steel required to come from US sources?**

No. Raw materials, such as iron ore, limestone, scrap iron, and scrap steel, can come from non-US sources.

**18) If an above listed item is primarily made of iron or steel, but is only at the construction site temporarily, must such an item be produced in the US?**

No. Only the above listed products made primarily of iron or steel, permanently incorporated into the project must be produced in the US. For example trench boxes, scaffolding or equipment, which are removed from the project site upon completion of the project, are not required to be made of U.S. Iron or Steel.

**19) What is the definition of ‘municipal castings’?**

Municipal castings are cast iron or steel infrastructure products that are melted and cast. They typically provide access, protection, or housing for components incorporated into utility owned drinking water, storm water, wastewater, and surface infrastructure. They are typically made of grey or ductile iron, or steel. Examples of municipal castings are:

- Access Hatches;
- Ballast Screen;
- Benches (Iron or Steel);
- Bollards;
- Cast Bases;
- Cast Iron Hinged Hatches, Square and Rectangular;
- Cast Iron Riser Rings;
- Catch Basin Inlet;
- Cleanout/Monument Boxes;
- Construction Covers and Frames;
- Curb and Corner Guards;
- Curb Openings;
- Detectable Warning Plates;
- Downspout Shoes (Boot, Inlet);
- Drainage Grates, Frames and Curb Inlets;
- Inlets;
- Junction Boxes;
- Lampposts;
- Manhole Covers, Rings and Frames, Risers;



Meter Boxes;  
Service Boxes;  
Steel Hinged Hatches, Square and Rectangular;  
Steel Riser Rings;  
Trash receptacles;  
Tree Grates;  
Tree Guards;  
Trench Grates; and  
Valve Boxes, Covers and Risers.

## **20) What is ‘structural steel’?**

Structural steel is rolled flanged shapes, having at least one dimension of their cross-section three inches or greater, which are used in the construction of bridges, buildings, ships, railroad rolling stock, and for numerous other constructional purposes. Such shapes are designated as wide-flange shapes, standard I-beams, channels, angles, tees and zees. Other shapes include H-piles, sheet piling, tie plates, cross ties, and those for other special purposes.

## **21) What is a ‘construction material’ for purposes of the AIS requirement?**

Construction materials are those articles, materials, or supplies made primarily of iron and steel, that are permanently incorporated into the project, not including mechanical and/or electrical components, equipment and systems. Some of these products may overlap with what is also considered “structural steel”. This includes, but is not limited to, the following products: wire rod, bar, angles, concrete reinforcing bar, wire, wire cloth, wire rope and cables, tubing, framing, joists, trusses, fasteners (i.e., nuts and bolts), welding rods, decking, grating, railings, stairs, access ramps, fire escapes, ladders, wall panels, dome structures, roofing, ductwork, surface drains, cable hanging systems, manhole steps, fencing and fence tubing, guardrails, doors, and stationary screens.

## **22) What is not considered a ‘construction material’ for purposes of the AIS requirement?**

Mechanical and electrical components, equipment and systems are not considered construction materials. Mechanical equipment is typically that which has motorized parts and/or is powered by a motor. Electrical equipment is typically any machine powered by electricity and includes components that are part of the electrical distribution system.

The following examples (including their appurtenances necessary for their intended use and operation) are NOT considered construction materials: pumps, motors, gear reducers, drives (including variable frequency drives (VFDs)), electric/pneumatic/manual accessories used to operate valves (such as electric valve actuators), mixers, gates, motorized screens (such as traveling screens), blowers/aeration equipment, compressors, meters, sensors, controls and switches, supervisory control and

data acquisition (SCADA), membrane bioreactor systems, membrane filtration systems, filters, clarifiers and clarifier mechanisms, rakes, grinders, disinfection systems, presses (including belt presses), conveyors, cranes, HVAC (excluding ductwork), water heaters, heat exchangers, generators, cabinetry and housings (such as electrical boxes/enclosures), lighting fixtures, electrical conduit, emergency life systems, metal office furniture, shelving, laboratory equipment, analytical instrumentation, and dewatering equipment.

**23) If the iron or steel is produced in the US, may other steps in the manufacturing process take place outside of the US, such as assembly?**

No. Production in the US of the iron or steel used in a listed product requires that all manufacturing processes must take place in the United States, except metallurgical processes involving refinement of steel additives.

**24) What processes must occur in the US to be compliant with the AIS requirement for reinforced precast concrete?**

While reinforced precast concrete may not be at least 50% iron or steel, in this particular case, the reinforcing bar and wire must be produced in the US and meet the same standards as for any other iron or steel product. Additionally, the casting of the concrete product must take place in the US. The cement and other raw materials used in concrete production are not required to be of domestic origin.

If the reinforced concrete is cast at the construction site, the reinforcing bar and wire are considered to be a construction material and must be produced in the US.

**Compliance**

**25) How should an assistance recipient document compliance with the AIS requirement?**

In order to ensure compliance with the AIS requirement, specific AIS contract language must be included in each contract, starting with the assistance agreement, all the way down to the purchase agreements. Sample language for assistance agreements and contracts can be found in Appendix 3 and 4.

EPA recommends the use of a step certification process, similar to one used by the Federal Highway Administration. The step certification process is a method to ensure that producers adhere to the AIS requirement and assistance recipients can verify that products comply with the AIS requirement. The process also establishes accountability and better enables States to take enforcement actions against violators.

Step certification creates a paper trail which documents the location of the manufacturing process involved with the production of steel and iron materials. A step certification is a process under which each handler (supplier, fabricator, manufacturer,

processor, etc) of the iron and steel products certifies that their step in the process was domestically performed. Each time a step in the manufacturing process takes place, the manufacturer delivers its work along with a certification of its origin. A certification can be quite simple. Typically, it includes the name of the manufacturer, the location of the manufacturing facility where the product or process took place (not its headquarters), a description of the product or item being delivered, and a signature by a manufacturer's responsible party. Attached, as Appendix 5, are sample certifications. These certifications should be collected and maintained by assistance recipients.

Alternatively, the final manufacturer that delivers the iron or steel product to the worksite, vendor, or contractor, may provide a certification asserting that all manufacturing processes occurred in the US. While this type of certification may be acceptable, it may not provide the same degree of assurance. Additional documentation may be needed if the certification is lacking important information. Step certification is the best practice.

**26) How should a State ensure assistance recipients are complying with the AIS requirement?**

In order to ensure compliance with the AIS requirement, States SRF programs must include specific AIS contract language in the assistance agreement. Sample language for assistance agreements can be found in Appendix 3.

States should also, as a best practice, conduct site visits of projects during construction and review documentation demonstrating proof of compliance which the assistance recipient has gathered.

**27) What happens if a State or EPA finds a non-compliant iron and/or steel product permanently incorporated in the project?**

If a potentially non-compliant product is identified, the State should notify the assistance recipient of the apparent unauthorized use of the non-domestic component, including a proposed corrective action, and should be given the opportunity to reply. If unauthorized use is confirmed, the State can take one or more of the following actions: request a waiver where appropriate; require the removal of the non-domestic item; or withhold payment for all or part of the project. Only EPA can issue waivers to authorize the use of a non-domestic item. EPA may use remedies available to it under the Clean Water Act, the Safe Drinking Water Act, and 40 CFR part 31 grant regulations, in the event of a violation of a grant term and condition.

It is recommended that the State work collaboratively with EPA to determine the appropriate corrective action, especially in cases where the State is the one who identifies the item in noncompliance or there is a disagreement with the assistance recipient.

If fraud, waste, abuse, or any violation of the law is suspected, the Office of Inspector General (OIG) should be contacted immediately. The OIG can be reached at 1-

888-546-8740 or [OIG\\_Hotline@epa.gov](mailto:OIG_Hotline@epa.gov). More information can be found at this website: <http://www.epa.gov/oig/hotline.htm>.

## **28) How do international trade agreements affect the implementation of the AIS requirements?**

The AIS provision applies in a manner consistent with United States obligations under international agreements. Typically, these obligations only apply to direct procurement by the entities that are signatories to such agreements. In general, SRF assistance recipients are not signatories to such agreements, so these agreements have no impact on this AIS provision. In the few instances where such an agreement applies to a municipality, that municipality is under the obligation to determine its applicability and requirements and document the actions taken to comply for the State.

### **Waiver Process**

The statute permits EPA to issue waivers for a case or category of cases where EPA finds (1) that applying these requirements would be inconsistent with the public interest; (2) iron and steel products are not produced in the US in sufficient and reasonably available quantities and of a satisfactory quality; or (3) inclusion of iron and steel products produced in the US will increase the cost of the overall project by more than 25 percent.

In order to implement the AIS requirements, EPA has developed an approach to allow for effective and efficient implementation of the waiver process to allow projects to proceed in a timely manner. The framework described below will allow States, on behalf of the assistance recipients, to apply for waivers of the AIS requirement directly to EPA Headquarters. Only waiver requests received from states will be considered. Pursuant to the Act, EPA has the responsibility to make findings as to the issuance of waivers to the AIS requirements.

### **Definitions**

The following terms are critical to the interpretation and implementation of the AIS requirements and apply to the process described in this memorandum:

Reasonably Available Quantity: The quantity of iron or steel products is available or will be available at the time needed and place needed, and in the proper form or specification as specified in the project plans and design.

Satisfactory Quality: The quality of iron or steel products, as specified in the project plans and designs.

Assistance Recipient: A borrower or grantee that receives funding from a State CWSRF or DWSRF program.

## **Step-By-Step Waiver Process**

### Application by Assistance Recipient

Each local entity that receives SRF water infrastructure financial assistance is required by section 436 of the Act to use American made iron and steel products in the construction of its project. However, the recipient may request a waiver. Until a waiver is granted by EPA, the AIS requirement stands, except as noted above with respect to municipalities covered by international agreements.

The waiver process begins with the SRF assistance recipient. In order to fulfill the AIS requirement, the assistance recipient must in good faith design the project (where applicable) and solicit bids for construction with American made iron and steel products. It is essential that the assistance recipient include the AIS terms in any request for proposals or solicitations for bids, and in all contracts (see Appendix 3 for sample construction contract language). The assistance recipient may receive a waiver at any point before, during, or after the bid process, if one or more of three conditions is met:

1. Applying the American Iron and Steel requirements of the Act would be inconsistent with the public interest;
2. Iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or
3. Inclusion of iron and steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

Proper and sufficient documentation must be provided by the assistance recipient. A checklist detailing the types of information required for a waiver to be processed is attached as Appendix 1.

Additionally, it is strongly encouraged that assistance recipients hold pre-bid conferences with potential bidders. A pre-bid conference can help to identify iron and steel products needed to complete the project as described in the plans and specifications that may not be available from domestic sources. It may also identify the need to seek a waiver prior to bid, and can help inform the recipient on compliance options.

In order to apply for a project waiver, the assistance recipient should email the request in the form of a Word document (.doc) to the State SRF program. It is strongly recommended that the State designate a single person for all AIS communications. The State SRF designee will review the application for the waiver and determine whether the necessary information has been included. Once the waiver application is complete, the State designee will forward the application to either of two email addresses. For CWSRF waiver requests, please send the application to: [cwsrfwaiver@epa.gov](mailto:cwsrfwaiver@epa.gov). For DWSRF waiver requests, please send the application to: [dwsrfwaiver@epa.gov](mailto:dwsrfwaiver@epa.gov).

## Evaluation by EPA

After receiving an application for waiver of the AIS requirements, EPA Headquarters will publish the request on its website for 15 days and receive informal comment. EPA Headquarters will then use the checklist in Appendix 2 to determine whether the application properly and adequately documents and justifies the statutory basis cited for the waiver – that it is quantitatively and qualitatively sufficient – and to determine whether or not to grant the waiver.

In the event that EPA finds that adequate documentation and justification has been submitted, the Administrator may grant a waiver to the assistance recipient. EPA will notify the State designee that a waiver request has been approved or denied as soon as such a decision has been made. Granting such a waiver is a three-step process:

1. Posting – After receiving an application for a waiver, EPA is required to publish the application and all material submitted with the application on EPA’s website for 15 days. During that period, the public will have the opportunity to review the request and provide informal comment to EPA. The website can be found at: [http://water.epa.gov/grants\\_funding/aisrequirement.cfm](http://water.epa.gov/grants_funding/aisrequirement.cfm)
2. Evaluation – After receiving an application for waiver of the AIS requirements, EPA Headquarters will use the checklist in Appendix 2 to determine whether the application properly and adequately documents and justifies the statutory basis cited for the waiver – that it is quantitatively and qualitatively sufficient – and to determine whether or not to grant the waiver.
3. Signature of waiver approval by the Administrator or another agency official with delegated authority – As soon as the waiver is signed and dated, EPA will notify the State SRF program, and post the signed waiver on our website. The assistance recipient should keep a copy of the signed waiver in its project files.

## Public Interest Waivers

EPA has the authority to issue public interest waivers. Evaluation of a public interest waiver request may be more complicated than that of other waiver requests so they may take more time than other waiver requests for a decision to be made. An example of a public interest waiver that might be issued could be for a community that has standardized on a particular type or manufacturer of a valve because of its performance to meet their specifications. Switching to an alternative valve may require staff to be trained on the new equipment and additional spare parts would need to be purchased and stocked, existing valves may need to be unnecessarily replaced, and portions of the system may need to be redesigned. Therefore, requiring the community to install an alternative valve would be inconsistent with public interest.

EPA also has the authority to issue a public interest waiver that covers categories of products that might apply to all projects.

EPA reserves the right to issue national waivers that may apply to particular classes of assistance recipients, particular classes of projects, or particular categories of iron or steel products. EPA may develop national or (US geographic) regional categorical waivers through the identification of similar circumstances in the detailed justifications presented to EPA in a waiver request or requests. EPA may issue a national waiver based on policy decisions regarding the public's interest or a determination that a particular item is not produced domestically in reasonably available quantities or of a sufficient quality. In such cases, EPA may determine it is necessary to issue a national waiver.

If you have any questions concerning the contents of this memorandum, you may contact us, or have your staff contact Jordan Dorfman, Attorney-Advisor, State Revolving Fund Branch, Municipal Support Division, at [dorfman.jordan@epa.gov](mailto:dorfman.jordan@epa.gov) or (202) 564-0614 or Kiri Anderer, Environmental Engineer, Infrastructure Branch, Drinking Water Protection Division, at [anderer.kirsten@epa.gov](mailto:anderer.kirsten@epa.gov) or (202) 564-3134.

Attachments

## Appendix 1: Information Checklist for Waiver Request

The purpose of this checklist is to help ensure that all appropriate and necessary information is submitted to EPA. EPA recommends that States review this checklist carefully and provide all appropriate information to EPA. This checklist is for informational purposes only and does not need to be included as part of a waiver application.

Items	✓	Notes
<p>General</p> <ul style="list-style-type: none"> <li>• Waiver request includes the following information:               <ul style="list-style-type: none"> <li>— Description of the foreign and domestic construction materials</li> <li>— Unit of measure</li> <li>— Quantity</li> <li>— Price</li> <li>— Time of delivery or availability</li> <li>— Location of the construction project</li> <li>— Name and address of the proposed supplier</li> <li>— A detailed justification for the use of foreign construction materials</li> </ul> </li> <li>• Waiver request was submitted according to the instructions in the memorandum</li> <li>• Assistance recipient made a good faith effort to solicit bids for domestic iron and steel products, as demonstrated by language in requests for proposals, contracts, and communications with the prime contractor</li> </ul>		
<p>Cost Waiver Requests</p> <ul style="list-style-type: none"> <li>• Waiver request includes the following information:               <ul style="list-style-type: none"> <li>— Comparison of overall cost of project with domestic iron and steel products to overall cost of project with foreign iron and steel products</li> <li>— Relevant excerpts from the bid documents used by the contractors to complete the comparison</li> <li>— Supporting documentation indicating that the contractor made a reasonable survey of the market, such as a description of the process for identifying suppliers and a list of contacted suppliers</li> </ul> </li> </ul>		
<p>Availability Waiver Requests</p> <ul style="list-style-type: none"> <li>• Waiver request includes the following supporting documentation necessary to demonstrate the availability, quantity, and/or quality of the materials for which the waiver is requested:               <ul style="list-style-type: none"> <li>— Supplier information or pricing information from a reasonable number of domestic suppliers indicating availability/delivery date for construction materials</li> <li>— Documentation of the assistance recipient's efforts to find available domestic sources, such as a description of the process for identifying suppliers and a list of contacted suppliers.</li> <li>— Project schedule</li> <li>— Relevant excerpts from project plans, specifications, and permits indicating the required quantity and quality of construction materials</li> </ul> </li> <li>• Waiver request includes a statement from the prime contractor and/or supplier confirming the non-availability of the domestic construction materials for which the waiver is sought</li> <li>• Has the State received other waiver requests for the materials described in this waiver request, for comparable projects?</li> </ul>		



## Appendix 2: HQ Review Checklist for Waiver Request

Instructions: To be completed by EPA. Review all waiver requests using the questions in the checklist, and mark the appropriate box as Yes, No or N/A. Marks that fall inside the shaded boxes may be grounds for denying the waiver. If none of your review markings fall into a shaded box, the waiver is eligible for approval if it indicates that one or more of the following conditions applies to the domestic product for which the waiver is sought:

1. The iron and/or steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality.
2. The inclusion of iron and/or steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

Review Items	Yes	No	N/A	Comments
<b>Cost Waiver Requests</b> <ul style="list-style-type: none"> <li>• Does the waiver request include the following information?               <ul style="list-style-type: none"> <li>– Comparison of overall cost of project with domestic iron and steel products to overall cost of project with foreign iron and steel products</li> <li>– Relevant excerpts from the bid documents used by the contractors to complete the comparison</li> <li>– A sufficient number of bid documents or pricing information from domestic sources to constitute a reasonable survey of the market</li> </ul> </li> <li>• Does the Total Domestic Project exceed the Total Foreign Project Cost by more than 25%?</li> </ul>				
<b>Availability Waiver Requests</b> <ul style="list-style-type: none"> <li>• Does the waiver request include supporting documentation sufficient to show the availability, quantity, and/or quality of the iron and/or steel product for which the waiver is requested?               <ul style="list-style-type: none"> <li>– Supplier information or other documentation indicating availability/delivery date for materials</li> <li>– Project schedule</li> <li>– Relevant excerpts from project plans, specifications, and permits indicating the required quantity and quality of materials</li> </ul> </li> <li>• Does supporting documentation provide sufficient evidence that the contractors made a reasonable effort to locate domestic suppliers of materials, such as a description of the process for identifying suppliers and a list of contacted suppliers?</li> <li>• Based on the materials delivery/availability date indicated in the supporting documentation, will the materials be unavailable when they are needed according to the project schedule? (By item, list schedule date and domestic delivery quote date or other relevant information)</li> <li>• Is EPA aware of any other evidence indicating the non-availability of the materials for which the waiver is requested? Examples include:               <ul style="list-style-type: none"> <li>– Multiple waiver requests for the materials described in this waiver request, for comparable projects in the same State</li> <li>– Multiple waiver requests for the materials described in this waiver request, for comparable projects in other States</li> <li>– Correspondence with construction trade associations indicating the non-availability of the materials</li> </ul> </li> <li>• Are the available domestic materials indicated in the bid documents of inadequate quality compared those required by the project plans, specifications, and/or permits?</li> </ul>				

### **Appendix 3: Example Loan Agreement Language**

ALL ASSISTANCE AGREEMENT MUST HAVE A CLAUSE REQUIRING COMPLIANCE WITH THE AIS REQUIREMENT. THIS IS AN EXAMPLE OF WHAT COULD BE INCLUDED IN SRF ASSISTANCE AGREEMENTS. EPA MAKES NO CLAIMS REGARDING THE LEGALITY OF THIS CLAUSE WITH RESPECT TO STATE LAW:

Comply with all federal requirements applicable to the Loan (including those imposed by the 2014 Appropriations Act and related SRF Policy Guidelines) which the Participant understands includes, among other, requirements that all of the iron and steel products used in the Project are to be produced in the United States (“American Iron and Steel Requirement”) unless (i) the Participant has requested and obtained a waiver from the Agency pertaining to the Project or (ii) the Finance Authority has otherwise advised the Participant in writing that the American Iron and Steel Requirement is not applicable to the Project.

Comply with all record keeping and reporting requirements under the Clean Water Act/Safe Drinking Water Act, including any reports required by a Federal agency or the Finance Authority such as performance indicators of program deliverables, information on costs and project progress. The Participant understands that (i) each contract and subcontract related to the Project is subject to audit by appropriate federal and state entities and (ii) failure to comply with the Clean Water Act/Safe Drinking Water Act and this Agreement may be a default hereunder that results in a repayment of the Loan in advance of the maturity of the Bonds and/or other remedial actions.

#### **Appendix 4: Sample Construction Contract Language**

ALL CONTRACTS MUST HAVE A CLAUSE REQUIRING COMPLIANCE WITH THE AIS REQUIREMENT. THIS IS AN EXAMPLE OF WHAT COULD BE INCLUDED IN ALL CONTRACTS IN PROJECTS THAT USE SRF FUNDS. EPA MAKES NO CLAIMS REGARDING THE LEGALITY OF THIS CLAUSE WITH RESPECT TO STATE OR LOCAL LAW:

The Contractor acknowledges to and for the benefit of the City of \_\_\_\_\_ (“Purchaser”) and the \_\_\_\_\_ (the “State”) that it understands the goods and services under this Agreement are being funded with monies made available by the Clean Water State Revolving Fund and/or Drinking Water State Revolving Fund that have statutory requirements commonly known as “American Iron and Steel;” that requires all of the iron and steel products used in the project to be produced in the United States (“American Iron and Steel Requirement”) including iron and steel products provided by the Contractor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Purchaser and the State that (a) the Contractor has reviewed and understands the American Iron and Steel Requirement, (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirement, as may be requested by the Purchaser or the State. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser or State to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney’s fees) incurred by the Purchaser or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Purchaser). While the Contractor has no direct contractual privity with the State, as a lender to the Purchaser for the funding of its project, the Purchaser and the Contractor agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State.

## Appendix 5: Sample Certifications

The following information is provided as a sample letter of **step** certification for AIS compliance. Documentation must be provided on company letterhead.

Date

Company Name

Company Address

City, State Zip

Subject: American Iron and Steel Step Certification for Project (XXXXXXXXXX)

I, (company representative), certify that the (melting, bending, coating, galvanizing, cutting, etc.) process for (manufacturing or fabricating) the following products and/or materials shipped or provided for the subject project is in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

Item, Products and/or Materials:

1. XXXX
2. XXXX
3. XXXX

Such process took place at the following location:

\_\_\_\_\_

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

The following information is provided as a sample letter of certification for AIS compliance. Documentation must be provided on company letterhead.

Date

Company Name

Company Address

City, State Zip

Subject: American Iron and Steel Certification for Project (XXXXXXXXXXXX)

I, (company representative), certify that the following products and/or materials shipped/provided to the subject project are in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

Item, Products and/or Materials:

1. XXXX
2. XXXX
3. XXXX

Such process took place at the following location:

\_\_\_\_\_

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

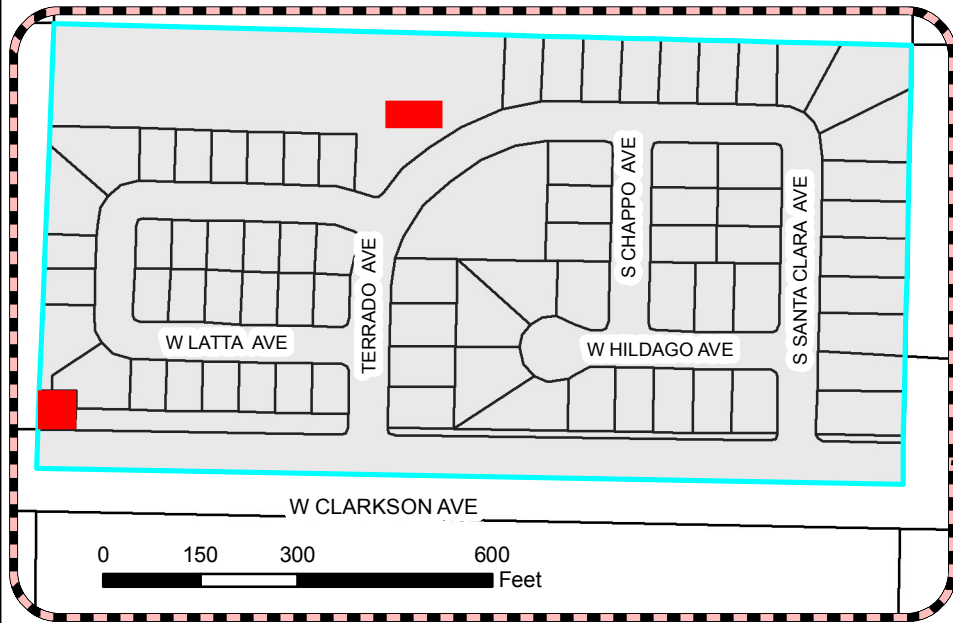
Signed by company representative

# Project Details

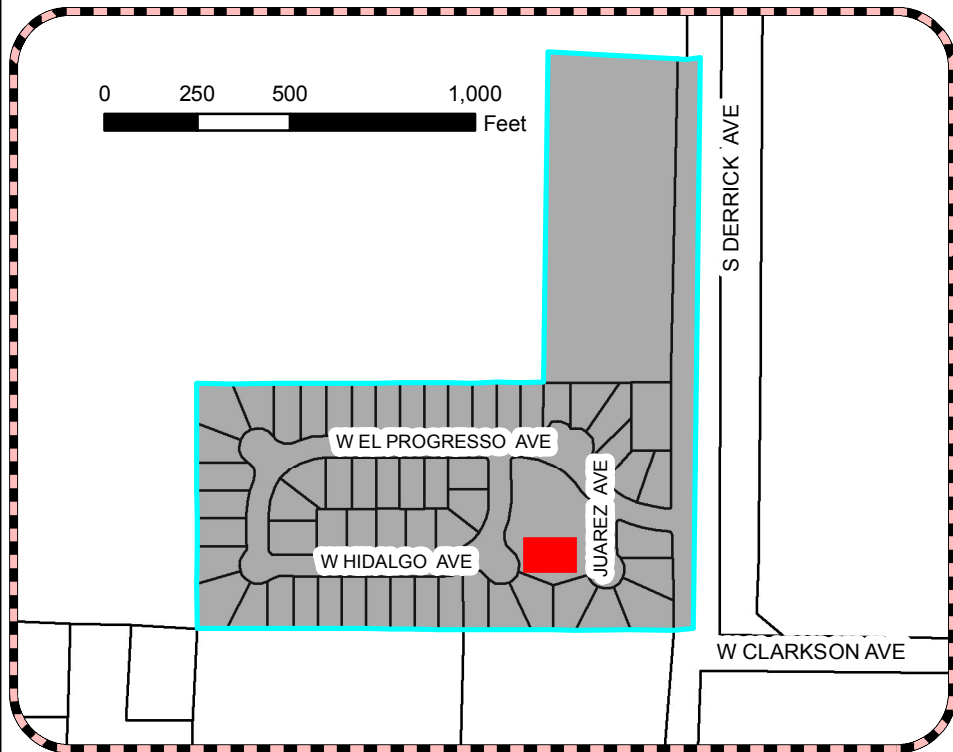
# LOCATION MAPS

## CSA 30 & 32: Fresno County Westside Groundwater Project Well Site Improvements & Manganese Treatment

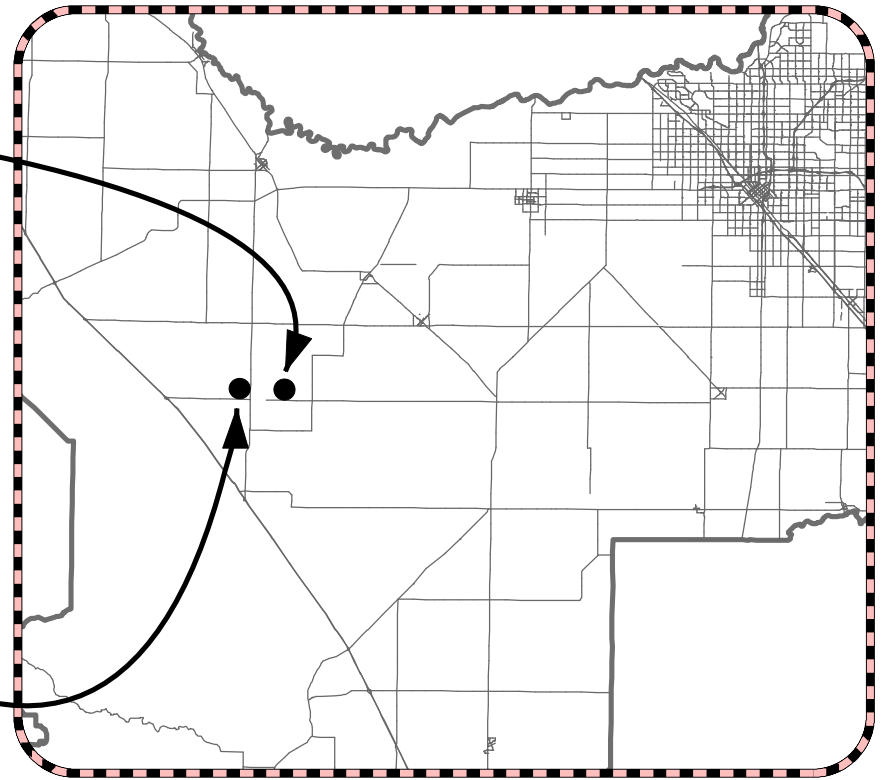
### PROJECT LOCATION MAPS



CSA #32 DISTRICT SHADED



CSA #30 DISTRICT SHADED



PROJECT LOCATED IN DISTRICT #1

APPROXIMATE SITE LOCATION



DEPARTMENT OF PUBLIC WORKS AND PLANNING

## PROJECT SIGNAGE


The Contactor shall place a funding sign at a prominent location, as designated by the County. The sign shall be at least four feet tall by eight feet wide and made of ¾ inch thick exterior grade plywood. The sign shall be supported by two 16 feet tall, 4x4 smooth wood posts, painted white. All logos are available from the California State Water Resources Control Board, Division of Financial Assistance, and are downloadable on their website. The sign shall be prepared in a professional manner. The sign shall be kept in good condition for the duration of construction.

See below for the sign template.

**County of Fresno - Westside Groundwater Project**  
**Project No. 1000359-005C**  
**Total Project Cost: \$Award\$**

Funding for this project has been provided in full or in part by the Proposition 1 - the Water Quality, Supply, and Infrastructure Improvement Act of 2014 and the Drinking Water State Revolving Fund through an agreement with the State Water Resources Control Board. California's Drinking Water State Revolving Fund is capitalized through a variety of funding sources, including grants from the United States Environmental Protection Agency and state bond proceeds.

This institution is an equal opportunity provider.



Actual Text size should reflect the text size depicted in the example.

Actual text style shall be Arial (normal) and the text color shall be black on a white background.

Actual Graphic Size should reflect the graphic size depicted in the example.

Project Cost should reflect the awarded bid.

**\*\*END OF SECTION\*\***



COUNTY OF FRESNO  
**REQUEST FOR CONSTRUCTION STAKING No. 1. Serial 042**

PROJECT CSA 30 & 32: GROUNDWATER PROJECT , WELL SITE IMPROVEMENTS & MANGANESE TREATMENT CONTRACT NO. 22-17-C

TYPE OF STAKING (Slope Stakes, Curb, FG EP, Wing Wall, Pipe, R/W, etc.)	STAKES ARE		LOCATION AND DESCRIPTION (Line, from station to station, offset, side, structure, etc.)	DATE STAKES WILL BE USED	DATE STAKES WERE SET
	ORIG.	RESET			

CONTRACTOR	COUNTY OF FRESNO
REQUESTED BY _____ DATE _____ (Contractor's Rep.)	RECEIVED BY _____ DATE _____ (Resident Engineer)
	COMPLETED BY _____ DATE _____ (Party Chief)

COMMENTS

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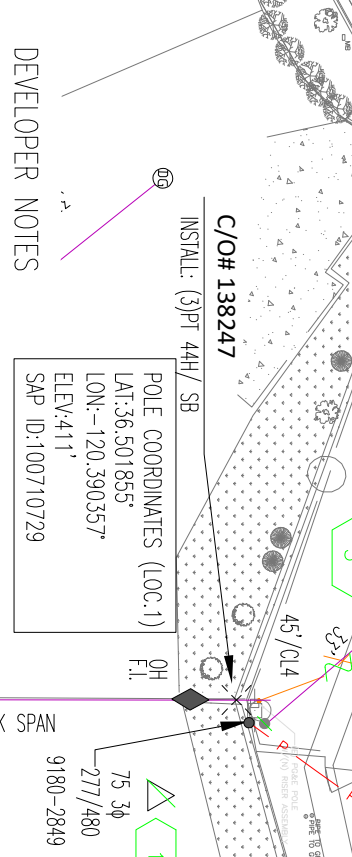


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**LEGEND**

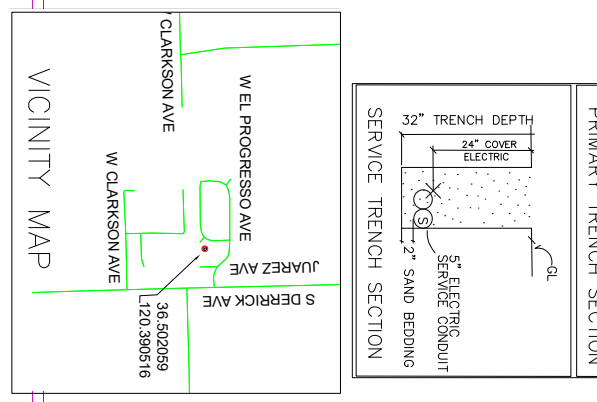
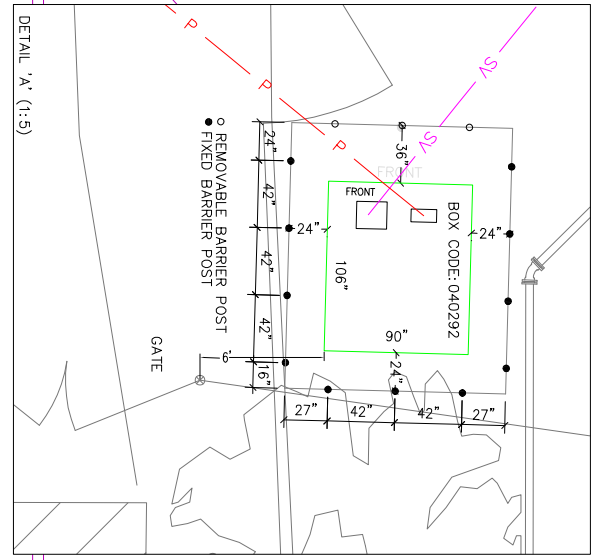
- REMOVE XFMR 75KVA
- INSTALL PAD MOUNT 150KVA
- INSTALL METER
- 1-750AL QPX IN 1 of 2-5"
- 3-1/0AL EPR 12KV IN 1-4"
- REMOVE METER
- REMOVE 4/0AL QPX
- INSTALL OH FAULT INDICATOR
- INSTALL CUTOUTS/FUSES
- INSTALL PRIMARY RISER
- REMOVE SVC RISER

**CREW NOTES**  
 DUE TO EASEMENT ISSUES RELATED TO SLACK SPAN AND LOC. 6, SUGGESTING TO USE VERTICAL PIN STANDOFF BRACKETS TO JUMPER DOWN TO CB3 CUTOUT ARM FOR TRADITIONAL PRIMARY RISER INSTALLATION.



**DEVELOPER NOTES**  
 BEFORE BEGINNING SUBSTRUCTURE WORK, PLEASE CALL THE UNDERGROUND INSPECTOR AT LEAST 48 HOURS IN ADVANCE AT (559-263-7312). (WORK NOT PROPERLY INSPECTED MAY BE REJECTED). IF THERE ARE ANY CONFLICTS BETWEEN SUBSTRUCTURES INSTALLATIONS AND LANDSCAPING CONTACT THE INSPECTOR PRIOR TO INSTALLATION.

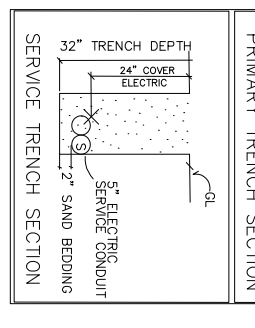
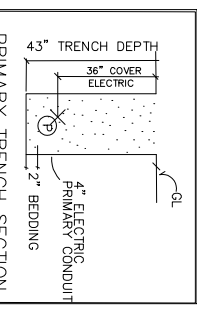
**CREW NOTES**  
 CUTOUTS/FUSES AT LOC. 6 HAVE BEEN REMOVED IN FIELD, BUT WILL NEED TO BE REINSTALLED BACK ON SINGLE C/O MOUNTING BRACKETS TO ACCOMMODATE VERTICAL FRAMING. IF THIS CANNOT BE REINSTALLED, ESTIMATING WILL NEED TO BE CONTACTED. THE SLACK SPAN CANNOT BE FLATTENED WITHOUT EASEMENTS FROM RESIDENTIAL CUSTOMER, WHICH COULD BE VERY DIFFICULT TO OBTAIN.



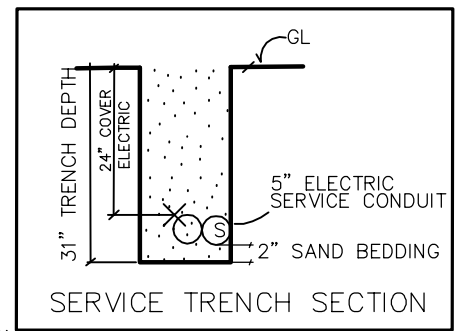
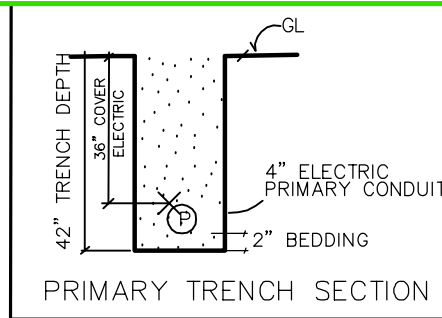
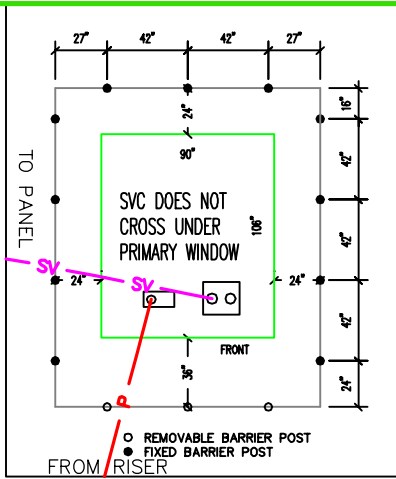
**NOTES:**

- 1) ALL DIMENSIONS AND LOCATIONS ARE ESTIMATED APPROXIMATE AND MAY BE SUPERSEDED BY A JOINT TRENCH DRAWING. REFER TO THE JOINT TRENCH COMPOSITE DRAWING FOR EXACT TRENCH LOCATION.
- 2) MAINTAIN WORKMAN PRACTICABLE HORIZONTAL CLEARANCE BETWEEN POLE FACILITIES AND "NET" UTILITIES (WATER, SEWER, STORM DRAIN, ETC.). THE MIN. ALLOWABLE SEPARATION BETWEEN POLE FACILITIES AND "NET" PARALLEL UTILITIES SHALL BE 18" FOR 48" OR SMALLER POLES AND 24" FOR 60" OR LARGER POLES.
- 3) THIS MEASUREMENT IS BETWEEN THE OUTER EDGE OF THE POLE MOUNT AND THE OUTER EDGE OF THE PARALLEL "NET" FACILITY. IF 3"/FT. CANNOT BE MAINTAINED, A FORMAL VARIANCE MUST BE OBTAINED FROM POLE WORK WITH THE POLE INSPECTOR (REFERENCE POLE UT STANDOFF 55453).
- 4) BOX, PAD, AND CONDUIT SIZES AND LOCATIONS SHALL CONFORM TO THE POLE ELECTRIC CONSTRUCTION DRAWING.
- 5) PROVIDE LENS CONDUIT WHERE INDICATED. RECOMMENDED SWEEP RADIUS (1" OF RADIUS PER INCH OF CONDUIT DIAMETER) EXAMPLE: 4" CONDUIT = 40" RADIUS
- 6) DO NOT EXCEED 300 DEGREES OF BENDS IN ANY CONDUIT RUN (INCLUDING FEED LOCATION). NOTE: SECONDARY AND SERVICE RUNS OF 200 FEET OR LESS MAY HAVE UP TO 315 DEGREES OF BENDS (REFERENCE POLE DOCUMENT 038193).
- 7) MANUFACTURED BENDS OR APPLICATION OF HEAT SHALL NOT BE USED TO OBTAIN LONG CONDUIT SWEEPS.
- 8) ALL CONDUITS SHALL BE PROVEN AND A POLYESTER PULL TAPE INSTALLED.
- 9) MANUFACTURED BENDS ARE NOT TO BE CUT, SHORTENED, OR ALTERED IN ANY WAY.
- 10) IDENTIFY ENDS OF BARED CONDUIT WITH AN ELECTRONIC MARKER AND A VERTICAL CONDUIT SCRAP INSTALLED FROM RIGID CAP TO GROUND LEVEL.
- 11) CONDUITS ENTERING PRIMARY BOXES SHALL BE AT A RIGHT ANGLE TO THE WINDOW OR WALL.
- 12) STUB CONDUITS AT RISER POLES IN QUADRANTS AS SHOWN AT DESIGNATED POLE LOCATIONS. THE TRENCHING AGENT IS TO EXCAVATE TO TRENCH DEPTH AND INSTALL A 30" DIAMETER CARBORUNDUM TUBE. THE RISER CONDUIT AROUND AND INSIDE TUBE WITH CLEAN WHITE FILL.
- 13) STREET LIGHT CONDUIT GOING TO POLE BOXES OR PEDSTALS NOT DESIGNATED AS P.O.S. (INCLUDING TRANSFORMERS) WILL NOT BE ACCEPTED OR CONNECTED.
- 14) ONLY ONE L2S STREET LIGHT (P.O.S.) CONNECTION PER BOX OR PEDestal.

- LAND RIGHTS AND EASEMENTS:**
- 14) APPLICANT TO PROVIDE ADEQUATE PLETS AND/OR ROWS FOR POLE FACILITIES. ANY ADDITIONAL, REQUIRED RIGHTS OF WAY ARE TO BE SURVEYED AND DOCUMENTED BY POLE AT THE APPLICANT'S EXPENSE.
- SAFETY AND WORKMANSHIP:**
- 15) CALL 811 (UNDERGROUND SERVICE ALERT) 48 HOURS PRIOR TO EXCAVATION FOR UNDERGROUND UTILITY LOCATION MARKING.
  - 16) 48 HOUR NOTICE REQUIRED FOR UNDERGROUND INSPECTION.
  - 17) MATERIALS AND WORKMANSHIP SHALL BE FIRST QUALITY IN EVERY RESPECT, PLUMB AND TRUE, AND ACCORDING TO THE SPECIFIC REQUIREMENTS OF THE DRAWINGS AND THE ABOVE APPLICABLE NOTES AND SPECIFICATIONS.
  - 18) THE APPLICANT IS TO VERIFY ALL PROPOSED INSTALLATIONS, CONDITIONS & SPECIFICATIONS PRIOR TO COMMENCING WITH ANY PORTION OF WORK. ANY DISCREPANCIES, OMISSIONS OR INCONSISTENCIES ARE TO BE REPORTED TO THE POLE REPRESENTATIVE IMMEDIATELY. THE APPLICANT SHALL COMPLY WITH ALL APPLICABLE SUBSTRUCTURE OR DESIGN.

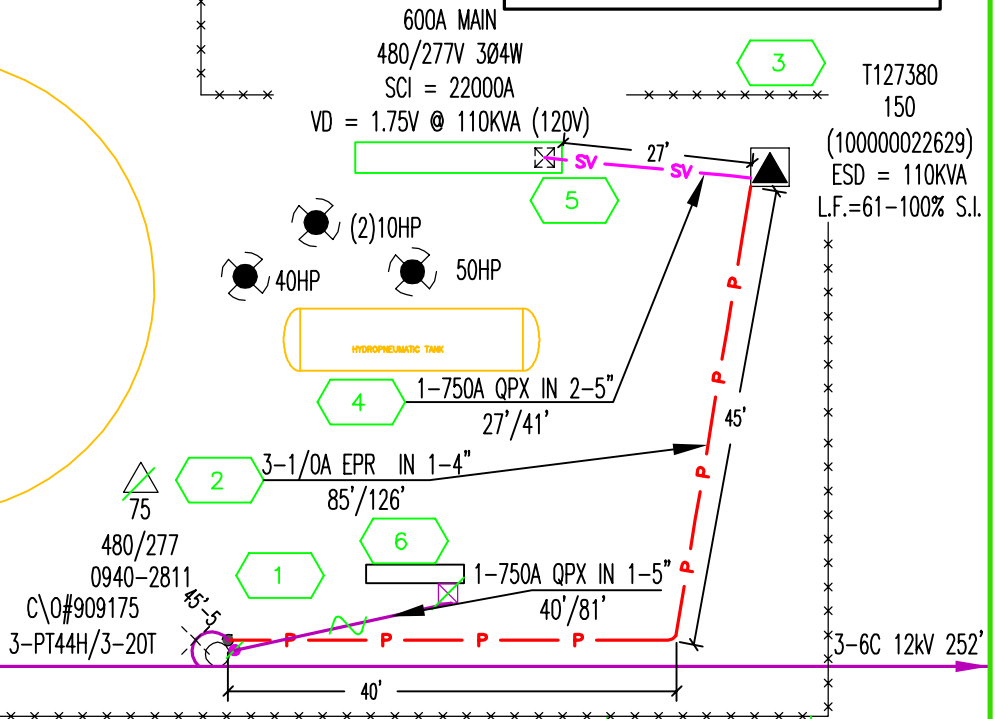


<p>CONSTRUCTION SKETCH                  SE SE SE 25 16 14                  CANTUA CREEK</p>		<p>ENGINEERING AND PLANNING DEPT.                  8 EAST RIVER PARK PL E                  FRESNO, CA 93720</p>		<p>EST: CHRIS SLUDER 559-573-4373                  ADE: MICHAEL STEWART 559-207-4837                  SUPV: HENRY DIAZ 0                  REP: ROBIN STRICKLAND 559-341-8748                  PLNR: JERRY VARGAS 559-263-7348</p>	
<p>PRIMARY VOLTAGE: 12 KV                  LATITUDE: 36.501872                  SOURCE SIDE DEVICE: 771777                  SUB &amp; CIRCUIT: CANTUA 1103</p>	<p>VOLTAGE AREA: 2                  LONGITUDE: -120.39019                  RAPTOR ZONE: YES                  ARRESTER DIST: 2                  INSULATION DIST: B</p>	<p>DSGN SAG:                  LOADING AREA: LIGHT                  CORROSION AREA: NON                  EXEMPT EQUIP. INST.: N/A</p>	<p>FIRE AREA: LRA-TIER 1</p>	<p>NOTIFY: 125795866                  SCALE: N.T.S.                  PM: 35437598</p>	<p>JPA#:                  DATE: 7/10/2023                  SHEET: 1 OF 1 REV. 0</p>



**LEGEND**

- REMOVE XFMR 75KVA
- INSTALL PAD MOUNT XFMR 150KVA
- INSTALL METER
- INSTALL 3-1/OAL EPR-CONC
- INSTALL 1-750AL QPX 2-5" DUCT
- INSTALL RISER ON PG&E POLE



CONSTRUCTION: REMOVE POLE BOLTED XFMR, INSTALL PRIMARY RISER AND INSTALL PRIMARY CABLE TO PAD AND XFMR, INSTALL SVC CABLE FROM XFMR TO PANEL.

POLE COORDINATES (LOC.1)  
 LAT: 36.501433°  
 LON: -120.329786°  
 ELEV: 298'  
 SAP ID: 100731679

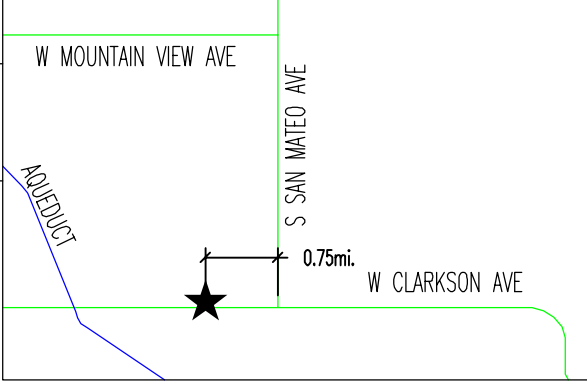


**PRIMARY FLICKER ANALYSIS RESULTS:**  
 PRIMARY FLICKER CALCULATES OUT TO **2.03** VOLTS (ON A 120 VOLT BASE)  
 FLICKER IS WITHIN LIMITS AND REDUCED-STARTING WILL NOT BE REQUIRED.  
 FLICKER IS NOT ACCEPTABLE AND REDUCED-STARTING WILL BE REQUIRED.  
 SR. NEW BUSINESS REP MUST NOTIFY CUSTOMER IN WRITING (WITH CC TO E&P) THAT MOTOR STARTING CURRENT MUST BE LIMITED TO THE FOLLOWING: **-----** AMPS AT **480** VOLTS.

**W CLARKSON AVE**

**VICINITY MAP**

1. APPLICANT TO INSTALL ALL CONDUITS
2. APPLICANT TO DO ALL TRENCHING, BACKFILLING, AND COMPACTING.
3. SAND SHADING REQUIRED AROUND ALL ELECTRICAL FACILITIES.
4. CALL UNDERGROUND SERVICE ALERT (USA) AT LEAST 48 HOURS PRIOR TO TRENCHING OR DIGGING. (811)
5. PG&E TO INSPECT TRENCH AND CONDUIT PRIOR TO BACKFILLING. CALL PG&E AT: (559) 263-7312



PRIMARY VOLTAGE: 12 kV	VOLTAGE AREA: 2
CKT. MAP:	ELEC.MAP: 1615276
SOURCE SIDE DEVICE: 9128	
SUB & CIRCUIT: GIFFEN 1103	
DSGN SAG: LtRural	RAPTOR ZONE: Y
LOADING AREA: N	ARRESTER DIST: 2
CORROSION AREA: N	INSULATION DIST: B
EXEMPT EQUIP. INST:	FIRE AREA: LRA

**CONSTRUCTION SKETCH**  
 CSA 30 Cantua Creek  
 SW SE SW 27 16 15, CANTUA CREEK

EST: CHRIS SLUDER	559-263-5571
ADE: BRIAN McMILLS	559 263-5618
SUPV: ED HORANIC	559-347-5024
REP: Paul Sytsma	559-263-5603
PLNR: Harpreet Bassi	559-263-5427
JPA#: N/A	SCALE: NTS
NOTIF: 113197386	DATE: 04/02/2018
PM: 35023981	SHEET: 1 OF 1   REV. 0

**811 Know what's below. Call before you dig.** NO ENVIRONMENTAL ISSUES. PG&E



**CONSTRUCTION PERMIT**

COUNTY OF FRESNO  
 DEVELOPMENT SERVICES DIVISION  
 MAILING ADDRESS: 2220 TULARE STREET, 6th FLOOR FRESNO, CA 93721  
 OFFICE LOCATION: SOUTHWEST CORNER OF TULARE  
 & M' STREETS, SUITE A

ACTIVE PERMITS YES NO

PHONE NUMBERS  
 24-HR REQUEST LINE  
 800-4131  
 LOCAL: 600-4560  
 TOLL FREE: 800-742-1011  
 FAX: 600-4201

15915 S JUAREZ CANTUA CREEK CA 93608

Ref #:21-1002

<u>Project Address</u> 15915 S JUAREZ CANTUA CREEK CA 93608		<u>Cross Street</u> DERRICK	<u>Project Description</u> CSA 30 - WATER TREATMENT PLANT EQUIPMENT UPGRADES		
Permit #: 23-011774-FC		Issued on:	APN: 03829144ST		
<u>Owner:</u> THE ROMAN CATHOLIC BISHOP OF FRESNO, A CORPORATION SOLE	<u>Applicant:</u>		<u>Contractor:</u>		
<u>Address:</u> 1550 N FRESNO ST FRESNO CA 93703 USA	<u>Address:</u>		<u>Address:</u>		
<u>Phone:</u> Work: (559)-488-7400	<u>Phone:</u>		<u>Phone:</u>		
	<u>License #:</u>		<u>License #:</u>		
<u>Approvals</u>		<u>Approved By</u>	<u>Date</u>		
Application Requirements		Permit Application Reviewer	Date		
Plan Review		Michael Granat	8/14/23 11:37AM		
<u>Zoning District</u>	<u>Required Setbacks:</u>	<u>Front</u>		<u>Side</u>	<u>Rear</u>
R1		Min	Max	Interior	Street
					Min
<b>PROJECT INFORMATION</b>					
: Area 1 (sf):370		: Big Dry Creek Basin:No			
: Construction Type 1:II-N		: FMFCD Rural Streams:No			
: Occupancy 1:Equipment Shelter		: Roof Classification:Class C or better			
: Soil Bearing Capacity(psf):500		: WMP Occupancy Pending:NO			
<b>MECHANICAL</b>					
1  Heating Appliance/Flue Vent		1  Exhaust Hood Forced Air Sy		1  Units Under 7 Tons	
<b>ELECTRICAL</b>					
21  Wiring Outlets		15  Circuits (remodel only)		2  Exterior Lighting Standards	
2  Motors over 5 HP - 30 HP		1  Motors over 30 HP - 50 HP		1  Motors over 150 HP	
6  Additional # of 50 HP Units		1  Transformer over 5 KVA - 30		1  Service/sub-panel 0 - 200 an	
<b>PLUMBING</b>					
1  Backflow Devices		1  Number of Bathrooms (3 max)		400  On-site Water Piping (ft)	
<b>LICENSED CONTRACTOR'S DECLARATION</b>					
I hereby affirm that I am licensed under provisions of Chapter 9 (commencing with Section 7000) of Division 8 of the Business and Professions Code, and my license is in full force and effect.Lic.					
Number _____		Class _____		Contractor _____	
FOR OWNER BUILDER SEE FORM F174 ATTACHE					
<b>WORKER'S COMPENSATION DECLARATION</b>					
I hereby affirm under penalty of perjury on of the following declarations:					
<input type="checkbox"/> I have and will maintain a certificate on consent to self-insure for workers' compensation as provided for by Section 3700 of the Labor code, for the performance of the work for which this permit is issued.					
<input type="checkbox"/> I have and will maintain workers' compensation insurance, as required by Section 3700 of the Labor Code for the performance of the work for which this permit is issued.					
My workers' compensation insurance carrier and policy number : _____					
Carrier _____ Policy # _____ (This section does not need to be completed if the permit is for one hundred dollars (\$100) or less.)					
<input type="checkbox"/> I certify that in the performance of the work for which this permit is issued, I shall not employ any person in any manner so as to become subject to the worker's compensation laws of California and agree that if I should become subject to the workers compensation provisions of Section 3700 of the Labor Code, I shall forthwith comply with those provisions.					
Applicant					
WARNING: FAILURE TO SECURE WORKERS' COMPENSATION COVERAGE IS UNLAWFUL AND SHALL SUBJECT AN EMPLOYER TO CRIMINAL PENALTIES AND CIVIL FINES UP TO ONE HUNDRED THOUSAND DOLLARS (\$100,000), IN ADDITION TO THE COST OF COMPENSATION. DAMAGES AS PROVIDED FOR IN SECTION 3706 OF THE LABOR CODE, INTEREST, AND ATTORNEY'S FEES.					
<b>CONSTRUCTION LENDING AGENCY</b>					
I hereby affirm that there is a construction lending agency for the performance of the work for which this permit is issued (Sec. 3097, Div. C).			I certify that I have read this application and state that the above information is correct. I agree to comply with all city and county ordinances and state laws relating to building construction, and hereby authorize representatives of this county to enter upon the above-mentioned property for inspection purposes.		
Lenders Name _____		Address _____		Applicant Or Agent _____	
City _____		State _____		Date _____	

THIS PERMIT SHALL EXPIRE BY LIMITATION AND BECOME NULL AND VOID IF THE WORK IS NOT COMMENCED OR IF NO INSPECTIONS ARE COMPLETED WITHIN 1 YEAR.

**Invoice**  
 County of Fresno  
 Department of Public Works & Planning  
 Mailing Address: 2220 Tulare Street, 6th Floor Fresno, CA 93721  
 24-HR REQUEST LINE: 600-4131 LOCAL: 600-4560  
 TOLL FREE: 800742-1011 FAX: 600-4201



**INVOICE TO:**

INVOICE NO: 274073

INVOICE DATE: August 14, 2023

PERMIT #: Folder 2023 011774 000 00 FC

REFERENCE #: 21-1002

PROJECT LOCATION: 15915 JUAREZ CANTUA CREEK CA

PROJECT DESCRIPTION: CSA 30 - WATER TREATMENT  
 PLANT EQUIPMENT UPGRADES

FEE DESCRIPTION	AMOUNT	COMMENT
CA Bldg Standards Comm. Fee (SB-1473)	\$1.00	
Workers Comp.	\$7.50	
Backflow Devices	\$29.00	Qty 1
Service/sub-panel 0 - 200 amps	\$29.00	Qty 1
Wiring Outlets	\$33.60	Qty 21
Electrical Permit Issuance	\$38.00	
Exhaust Hood Forced Air System <4000 cfm	\$38.00	Qty 1
Heating Appliance/Flue Vent	\$38.00	Qty 1
Mechanical Permit Issuance	\$38.00	
Plumbing Permit Issuance	\$38.00	
Units Under 7 Tons	\$38.00	Qty 1
Transformer over 5 KVA - 30 KVA	\$42.00	Qty 1
Exterior Lighting Standards	\$46.00	Qty 2
Minimum Electrical Permit fee	\$58.50	
Minimum Plumbing Permit fee	\$58.50	

Minimum Mechanical Permit fee	\$61.00	
Motors over 30 HP - 50 HP	\$64.00	Qty 1
Motors over 5 HP - 30 HP	\$84.00	Qty 2
On Site Water Piping (ft)	\$105.50	Qty 400
Motors over 150 HP	\$161.50	Qty 1
No of Bathrooms Dwellings Only Max 3	\$179.00	Qty 1
Circuits (remodel only)	\$180.00	Qty 15
Microfilm/Copies	\$223.00	
Additional # of 50 HP Units	\$342.00	Qty 6

<b>TOTAL</b>	<b>\$1,933.10</b>
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**SUMMARY**

ELECTRICAL PERMIT	<b>\$1,078.60</b>
MECHANICAL PERMIT	<b>\$213.00</b>
OTHER	<b>\$231.50</b>
PLUMBING PERMIT	<b>\$410.00</b>
<b>TOTAL</b>	<b>\$1,933.10</b>

<b>Total Billed:</b>	\$1,933.10
<b>Payment Received:</b>	\$0.00
<b>Balance Due:</b>	<b>\$1,933.10</b>

FORM OF PAYMENT:

- Check
- Credit Card
- Cash
- DrawDown-Acct#

**Roads Charge-Use Acct#** \_\_\_\_\_

Submitted by: \_\_\_\_\_ Ext: \_\_\_\_\_



**CONSTRUCTION PERMIT**  
**COUNTY OF FRESNO**  
**DEVELOPMENT SERVICES DIVISION**  
 MAILING ADDRESS: 2220 TULARE STREET, 6th FLOOR FRESNO, CA 93721  
 OFFICE LOCATION: SOUTHWEST CORNER OF TULARE  
 & 'M' STREETS, SUITE A

ACTIVE PERMITS YES NO  
 PHONE NUMBERS  
 24-HR REQUEST LINE  
 600-4131  
 LOCAL: 600-4560  
 TOLL FREE: 800-742-1011  
 FAX: 600-4201

29718 W CLARKSON AVE  
 CANTUA CREEK CA 93608

Ref #:

<b>Project Address</b> 29718 W CLARKSON AVE CANTUA CREEK CA 93608	<b>Cross Street</b> san mateo ave	<b>Project Description</b> CSA 32 - WATER TREATMENT PLANT EQUIPMENT UPGRADES
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Permit #: 23-011781-FC Issued on: \_\_\_\_\_ APN: 03834101ST

<b>Owner:</b> THE ROMAN CATHOLIC BISHOP OF FRESNO, A CORPORATION SOLE <b>Address:</b> 1550 N FRESNO ST FRESNO CA 93703 USA <b>Phone:</b> Work: (559)-488-7400	<b>Applicant:</b> <b>Address:</b> <b>Phone:</b> <b>License #:</b>	<b>Contractor:</b> <b>Address:</b> <b>Phone:</b> <b>License #:</b>
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<b>Approvals</b>	<b>Approved By</b>	<b>Date</b>
Application Requirements Plan Review	Permit Application Reviewer Michael Granat	8/14/23 11:47AM

Zoning District	Required Setbacks:	Front		Side		Rear
R1		Min	Max	Interior	Street	Min

**PROJECT INFORMATION**

: Area 1 (sf):140	: Big Dry Creek Basin:No
: Construction Type 1:II-N	: FMFCD Rural Streams:No
: MWEL0 Occupancy Pending:NO	: Occupancy 1:Patio (Commercial)
: Roof Classification:Class C or better	: Soil Bearing Capacity(psf):500
: Submittal Method:E-Mail	: WMP Occupancy Pending:NO

**MECHANICAL**

**ELECTRICAL**

10  Wiring Outlets	10  Circuits (remodel only)	2  Exterior Lighting Standards
2  Motors over 1 HP - 5 HP	2  Motors over 5 HP - 30 HP	1  Motors over 30 HP - 50 HP
1  Motors over 150 HP	6  Additional # of 50 HP Units	1  Transformer over 5 KVA - 30
1  Service/sub-panel 0 - 200 an	1  Service/sub-panel 401 - 600	

**PLUMBING**

1  Backflow Devices	400  On-site Water Piping (ft)
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**LICENSED CONTRACTOR'S DECLARATION**

I hereby affirm that I am licensed under provisions of Chapter 9 (commencing with Section 7000) of Division 8 of the Business and Professions Code, and my license is in full force and effect.Lic.

Number \_\_\_\_\_ Class \_\_\_\_\_ Contractor \_\_\_\_\_ **FOR OWNER BUILDER SEE FORM F174 ATTACHED**

**WORKER'S COMPENSATION DECLARATION**

I hereby affirm under penalty of perjury on of the following declarations:

I have and will maintain a certificate on consent to self-insure for workers' compensation as provided for by Section 3700 of the Labor code, for the performance of the work for which this permit is issued.

I have and will maintain workers' compensation insurance, as required by Section 3700 of the Labor Code for the performance of the work for which this permit is issued.

My workers' compensation insurance carrier and policy number :  
 Carrier \_\_\_\_\_ Policy # \_\_\_\_\_ (This section does not need to be completed if the permit is for one hundred dollars (\$100) or less.)

I certify that in the performance of the work for which this permit is issued, I shall not employ any person in any manner so as to become subject to the worker's compensation laws of California and agree that if I should become subject to the workers compensation provisions of Section 3700 of the Labor Code, I shall forthwith comply with those provisions.

Applicant \_\_\_\_\_

**WARNING: FAILURE TO SECURE WORKERS' COMPENSATION COVERAGE IS UNLAWFUL AND SHALL SUBJECT AN EMPLOYER TO CRIMINAL PENALTIES AND CIVIL FINES UP TO ONE HUNDRED THOUSAND DOLLARS (\$100,000), IN ADDITION TO THE COST OF COMPENSATION, DAMAGES AS PROVIDED FOR IN SECTION 3700 OF THE LABOR CODE, INTEREST, AND ATTORNEY'S FEES.**

**CONSTRUCTION LENDING AGENCY**

I hereby affirm that there is a construction lending agency for the performance of the work for which this permit is issued (Sec. 3597, Div. C).

Lenders Name \_\_\_\_\_ Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

I certify that I have read this application and state that the above information is correct. I agree to comply with all city and county ordinances and state laws relating to building construction, and hereby authorize representatives of this county to enter upon the above-mentioned property for inspection purposes.

Applicant Or Agent \_\_\_\_\_

Date \_\_\_\_\_

**THIS PERMIT SHALL EXPIRE BY LIMITATION AND BECOME NULL AND VOID IF THE WORK IS NOT COMMENCED OR IF NO INSPECTIONS ARE COMPLETED WITHIN 1 YEAR.**

**Invoice**  
 County of Fresno  
 Department of Public Works & Planning  
 Mailing Address: 2220 Tulare Street, 6th Floor Fresno, CA 93721  
 24-HR REQUEST LINE: 600-4131 LOCAL: 600-4560  
 TOLL FREE: 800742-1011 FAX: 600-4201



INVOICE TO:

INVOICE NO: 274074

INVOICE DATE: August 14, 2023

PERMIT #: Folder 2023 011781 000 00 FC

REFERENCE #:

PROJECT LOCATION: 29718 CLARKSON CANTUA CREEK CA

PROJECT DESCRIPTION: CSA 32 - WATER TREATMENT  
 PLANT EQUIPMENT UPGRADES

FEE DESCRIPTION	AMOUNT	COMMENT
CA Bldg Standards Comm. Fee (SB-1473)	\$1.00	
Workers Comp.	\$7.50	
Wiring Outlets	\$16.00	Qty 10
Call-In, Fax, Email or Internet	\$20.00	
Backflow Devices	\$29.00	Qty 1
Service/sub-panel 0 - 200 amps	\$29.00	Qty 1
Electrical Permit Issuance	\$38.00	
Plumbing Permit Issuance	\$38.00	
Transformer over 5 KVA - 30 KVA	\$42.00	Qty 1
Exterior Lighting Standards	\$46.00	Qty 2
Minimum Electrical Permit fee	\$58.50	
Minimum Plumbing Permit fee	\$58.50	
Motors over 30 HP - 50 HP	\$64.00	Qty 1
Motors over 1 HP - 5 HP	\$67.00	Qty 2
Additional Plan Check (building)	\$73.00	1



Motors over 5 HP - 30 HP	\$84.00	Qty 2
On Site Water Piping (ft)	\$105.50	Qty 400
Circuits (remodel only)	\$120.00	Qty 10
Overtime Plan Check	\$146.00	2
Service/sub-panel 401 - 600 amps	\$148.50	Qty 1
Motors over 150 HP	\$161.50	Qty 1
Microfilm/Copies	\$223.00	
Reversed Plan Review	\$297.00	3
Additional # of 50 HP Units	\$342.00	Qty 6

<b>TOTAL</b>	<b>\$2,215.00</b>
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**SUMMARY**

ELECTRICAL PERMIT	<b>\$1,216.50</b>
OTHER	<b>\$767.50</b>
PLUMBING PERMIT	<b>\$231.00</b>
<b>TOTAL</b>	<b>\$2,215.00</b>

<b>Total Billed:</b>	\$2,215.00
<b>Payment Received:</b>	\$0.00
<b>Balance Due:</b>	<b>\$2,215.00</b>

FORM OF PAYMENT:

- \_\_\_\_\_ Check  
 \_\_\_\_\_ Credit Card  
 \_\_\_\_\_ Cash  
 \_\_\_\_\_ DrawDown-Acct#

**Roads Charge-Use Acct#** \_\_\_\_\_

Submitted by: \_\_\_\_\_ Ext: \_\_\_\_\_



**DEPARTMENT OF PUBLIC HEALTH - ENVIRONMENTAL HEALTH DIVISION**  
 P.O. Box 11867 Zip 93775, 1221 Fulton Mall, Fresno, California 93721  
 Telephone: (559) 600-3357 Fax: (559) 600-7629 Website: www.fcdph.org/water  
**PERMIT TO CONSTRUCT, DEEPEN, DESTROY, RECONDITION, OR REPAIR A WELL**

Application Date \_\_\_\_\_ Estimated Start Date \_\_\_\_\_  
 T \_\_\_\_\_ R \_\_\_\_\_ S \_\_\_\_\_  
 APN \_\_\_\_\_ - \_\_\_\_\_ - \_\_\_\_\_  
 (ex### -### -##)  
 Contractor \_\_\_\_\_  
 License # \_\_\_\_\_  
 Phone \_\_\_\_\_ FAX \_\_\_\_\_

**OFFICE USE ONLY**

Well Permit# \_\_\_\_\_ FA# \_\_\_\_\_  
 Specialist \_\_\_\_\_ CT \_\_\_\_\_  
 **Corcoran Clay Depth** \_\_\_\_\_ Ft  
 (see Special Corcoran Clay Annular Seal Requirements on attachment)  
 **Well Location in Flood Zone.** (Extend Casing above known flood level; Flood Elevation Certificate required to be submitted to the Fresno Co. Public Works. Dept. prior to approval of the well electrical permit.)  
 Approved \_\_\_\_\_ Date \_\_\_\_\_ Seal Insp. \_\_\_\_\_ Date \_\_\_\_\_  
 Final Insp. \_\_\_\_\_ Date \_\_\_\_\_ Supervisor \_\_\_\_\_

Job Address/Location \_\_\_\_\_ Parcel Size \_\_\_\_\_  
 Owner Name \_\_\_\_\_ Owner Phone \_\_\_\_\_  
 Owner Address \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

<p><b>Type of Work</b></p> <input type="checkbox"/> New Well <input type="checkbox"/> Replacement Well <input type="checkbox"/> Reconstruction/Deepening <input type="checkbox"/> Test Hole <input type="checkbox"/> Destruction	<p><b>Type of Well</b></p> <input type="checkbox"/> Casing Driven <input type="checkbox"/> Cable Tool <input type="checkbox"/> Hardrock <input type="checkbox"/> Auger <input type="checkbox"/> Direct Rotary <input type="checkbox"/> Reverse Rotary	<p><b>Intended Use</b></p> <input type="checkbox"/> Domestic Private <input type="checkbox"/> Domestic Public <input type="checkbox"/> Agricultural <input type="checkbox"/> Industrial <input type="checkbox"/> Cathodic <input type="checkbox"/> Test Hole <input type="checkbox"/> Monitoring <input type="checkbox"/> Other	<p><b>Well Construction</b></p> Well Casing Material _____ Well Casing Diameter _____ in Well Casing Gauge _____ Conductor Casing Material _____ Conductor Casing Diameter _____ in Conductor Casing Depth _____ Ft Annular Seal Depth _____ Ft Borehole Diameter _____ in Gravel Pack <input type="checkbox"/> Yes <input type="checkbox"/> No
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**Well Destruction**  
 Type  Gravel Pack  Open Bottom  Uncased  Other \_\_\_\_\_  
 Well Diameter \_\_\_\_\_ In Total Depth \_\_\_\_\_ Ft  
 Depth to Water \_\_\_\_\_ Ft  
 Casing to be Perforated \_\_\_\_\_ Ft to \_\_\_\_\_ Ft  
 Casing cut off \_\_\_\_\_ Ft Below Grade (6ft max allowed)  
 Oil lubricated pump **(Any oil in the well shall be removed and properly disposed of prior to destruction)**

**Sealing Material/Seal Placement Method**

Neat Cement  Sand Cement  Concrete  
 Bentonite – Product Name \_\_\_\_\_  
 Pumped  Free Fall **(allowed only when the interval to be sealed is dry and less than 30 Ft depth)**

**Setbacks**  All setbacks exceed 300 Feet  Other Wells \_\_\_\_\_ Ft

Leach Lines \_\_\_\_\_ Ft  Septic Tank \_\_\_\_\_ Ft  Cesspool \_\_\_\_\_ Ft  Seepage Pits \_\_\_\_\_ Ft  
 Sewer Lines \_\_\_\_\_ Ft  Animal/Fowl Enclosure \_\_\_\_\_ Ft  Designated Sewage Replacement Area \_\_\_\_\_ Ft  
 Flood Control Basins \_\_\_\_\_ Ft  Waste Water Disposal Ponds \_\_\_\_\_ Ft  Lakes/Streams \_\_\_\_\_ Ft

**FEE**  \$605 (Domestic/Agricultural/ Cathodic/Test Hole PE4650, Public/Industrial PE4652 )  \$407 (Well Destruction PE4651)  
 **No Charge** (Monitoring Well/Soil Boring PE4653)  
 PAYMENT METHOD  Cash  Check  Credit Card (Authorization on file with Dept. of Public Health, Env. Health Division)

I hereby certify that the information described herein is correct. I understand that all work is to be done in accordance with the California Well Standards Ordinance and the conditions of this permit application, including any conditions which are added by the Environmental Health Division upon review of this application and issuance of the permit. I certify that I have a current C-57 Contractor's License and, if I employ workers, a current certificate of Workers' Compensation Insurance. I further understand that any permit issued pursuant to this application is subject to such further conditions as may be deemed necessary to ensure compliance with the Ordinance. **Note: This permit is non-transferable and is valid for 180 days.**

**CONTRACTOR SIGNATURE:** \_\_\_\_\_  
**DATE:** \_\_\_\_\_

**OFFICE USE ONLY - ENVISION CLERICAL:**

Account# \_\_\_\_\_ Invoice# \_\_\_\_\_  
 Entered By \_\_\_\_\_ Date \_\_\_\_\_  
**SPECIAL REQUIREMENTS:** \_\_\_\_\_ Faxed by \_\_\_\_\_



**DEPARTMENT OF PUBLIC HEALTH - ENVIRONMENTAL HEALTH DIVISION**  
P.O. Box 11867 Zip 93775, 1221 Fulton Mall, Fresno, California 93721  
Telephone: (559) 600-3357 Fax: (559) 600-7629 Website: [www.fcdph.org/water](http://www.fcdph.org/water)  
**PLOT PLAN TO ACCOMPANY PERMIT TO CONSTRUCT, DEEPEN, DESTROY,**

**RECONDITION, OR REPAIR A WELL**

**Note: This permit is non-transferable and is valid for 180 days**

Job Address / Location: \_\_\_\_\_ APN: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ PERMIT # \_\_\_\_\_

Indicate distances in feet. Provide the names of streets or roads nearest to the property. Provide dimensions of the property and all existing or proposed structures. Provide locations of existing or proposed sewage disposal systems, including expansion or repair areas, within 250 feet of the new well. Provide locations of all other wells within 300 feet of the new well. Location information shall include all adjacent parcels, if within setbacks.

I  
N

# SELF-DEALING TRANSACTION DISCLOSURE FORM

(1) Company Board Member Information:

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Job Title: \_\_\_\_\_

(2) Company/Agency Name and Address:

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(3) Disclosure (Please describe the nature of the self-dealing transaction you are a party to)

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(4) Explain why this self-dealing transaction is consistent with the requirements of Corporations Code 5233 (a)

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(5) Authorized Signature

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

## **SELF-DEALING TRANSACTION DISCLOSURE FORM INSTRUCTIONS**

In order to conduct business with the County of Fresno (hereinafter referred to as "County"), members of a contractor's board of directors (hereinafter referred to as "County Contractor"), must disclose any self-dealing transactions that they are a party to while providing goods, performing services, or both for the County. A self-dealing transaction is defined below:

*"A self-dealing transaction means a transaction to which the corporation is a party and which one or more of its directors has a material financial interest"*

The definition above will be utilized for purposes of completing the disclosure form.

- (1) Enter board member's name, job title (if applicable), and date this disclosure is being made.
- (2) Enter the board member's company/agency name and address.
- (3) Describe in detail the nature of the self-dealing transaction that is being disclosed to the County. At a minimum, include a description of the following:
  - a. The name of the agency/company with which the corporation has the transaction; and
  - b. The nature of the material financial interest in the Corporation's transaction that the board member has.
- (4) Describe in detail why the self-dealing transaction is appropriate based on applicable provisions of the Corporations Codes.
- (5) Form must be signed by the board member that is involved in the self-dealing transaction described in Sections (3) and (4).

**REVISED STANDARD SPECIFICATIONS DATED  
09-02-16**

**ORGANIZATION**

Revised standard specifications are under headings that correspond with the main-section headings of the *Standard Specifications*. A main-section heading is a heading shown in the table of contents of the *Standard Specifications*. A date under a main-section heading is the date of the latest revision to the section.

Each revision to the *Standard Specifications* begins with a revision clause that describes or introduces a revision to the *Standard Specifications*. For a revision clause that describes a revision, the date on the right above the clause is the publication date of the revision. For a revision clause that introduces a revision, the date on the right above a revised term, phrase, clause, paragraph, or section is the publication date of the revised term, phrase, clause, paragraph, or section. For a multiple-paragraph or multiple-section revision, the date on the right above a paragraph or section is the publication date of the paragraphs or sections that follow.

Any paragraph added or deleted by a revision clause does not change the paragraph numbering of the *Standard Specifications* for any other reference to a paragraph of the *Standard Specifications*.

^

**DIVISION I GENERAL PROVISIONS**

**1 GENERAL**

07-15-16

**Add to the 1st table of section 1-1.06:**

07-15-16

APCD	air pollution control district
AQMD	air quality management district
CISS	cast-in-steel shell
CSL	crosshole sonic logging
GGL	gamma-gamma logging

^

**7 LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC**

07-15-16

**Replace the paragraphs in section 7-1.02I(2) with:**

05-06-16

Under 2 CA Code of Regs § 11105:

1. During the performance of this contract, the recipient, contractor, and its subcontractors shall not deny the contract's benefits to any person on the basis of race, religious creed, color, national origin, ancestry, physical disability, mental disability, medical condition, genetic information, marital status, sex, gender, gender identity, gender expression, age, sexual orientation, or military and veteran status, nor shall they discriminate unlawfully against any employee or applicant for employment because of race, religious creed, color, national origin, ancestry, physical disability, mental disability, medical condition, genetic information, marital status, sex, gender, gender identity, gender

expression, age, sexual orientation, or military and veteran status. Contractor shall insure that the evaluation and treatment of employees and applicants for employment are free of such discrimination.

2. Contractor shall comply with the provisions of the Fair Employment and Housing Act (Gov. Code, § 12900 et seq.), the regulations promulgated thereunder (Cal. Code Regs., tit. 2, § 11000 et seq.), the provisions of Article 9.5, Chapter 1, Part 1, Division 3, Title 2 of the Government Code (Gov. Code, §§ 11135-11139.5), and the regulations or standards adopted by the awarding state agency to implement such article.
3. Contractor or recipient shall permit access by representatives of the Department of Fair Employment and Housing and the awarding state agency upon reasonable notice at any time during the normal business hours, but in no case less than 24 hours' notice, to such of its books, records, accounts, and all other sources of information and its facilities as said Department or Agency shall require to ascertain compliance with this clause.
4. Recipient, contractor and its subcontractors shall give written notice of their obligations under this clause to labor organizations with which they have a collective bargaining or other agreement.
5. The contractor shall include the nondiscrimination and compliance provisions of this clause in all subcontracts to perform work under the contract.

Under 2 CA Code of Regs § 11122:

### **STANDARD CALIFORNIA NONDISCRIMINATION CONSTRUCTION CONTRACT SPECIFICATIONS (GOV. CODE SECTION 12990)**

These specifications are applicable to all state contractors and subcontractors having a construction contract or subcontract of \$5,000 or more.

1. As used in the specifications:
  - a. "Act" means the Fair Employment and Housing Act.
  - b. "Administrator" means Administrator, Office of Compliance Programs, California Department of Fair Employment and Housing, or any person to whom the Administrator delegates authority;
2. Whenever the contractor or any subcontractor subcontracts a portion of the work, it shall include in each subcontract of \$5,000 or more the nondiscrimination clause in this contract directly or through incorporation by reference. Any subcontract for work involving a construction trade shall also include the Standard California Construction Contract Specifications, either directly or through incorporation by reference.
3. The contractor shall implement the specific nondiscrimination standards provided in paragraphs 6(a) through (e) of these specifications.
4. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the contractor has a collective bargaining agreement, to refer members of any group protected by the Act shall excuse the contractor's obligations under these specifications, Government Code section 12990, or the regulations promulgated pursuant thereto.5. In order for the nonworking training hours of apprentices and trainees to be counted, such apprentices and trainees must be employed by the contractor during the training period, and the contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor or the California Department of Industrial Relations.
5. In order for the nonworking training hours of apprentices and trainees to be counted, such apprentices and trainees must be employed by the contractor during the training period, and the contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor or the California Department of Industrial Relations.
6. The contractor shall take specific actions to implement its nondiscrimination program. The evaluation of the contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The contractor must be able to demonstrate fully its efforts under steps a. through e. below:
  - a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and at all facilities at which the contractor's employees are assigned to work. The contractor shall specifically ensure that all foremen, superintendents, and other on-site

- supervisory personnel are aware of and carry out the contractor's obligations to maintain such a working environment.
- b. Provide written notification within seven days to the director of the DFEH when the referral process of the union or unions with which the contractor has a collective bargaining agreement has impeded the contractor's efforts to meet its obligations.
  - c. Disseminate the contractor's equal employment opportunity policy by providing notice of the policy to unions and training, recruitment and outreach programs and requesting their cooperation in assisting the contractor to meet its obligations; and by posting the company policy on bulletin boards accessible to all employees at each location where construction work is performed.
  - d. Ensure all personnel making management and employment decisions regarding hiring, assignment, layoff, termination, conditions of work, training, rates of pay or other employment decisions, including all supervisory personnel, superintendents, general foremen, on-site foremen, etc., are aware of the contractor's equal employment opportunity policy and obligations, and discharge their responsibilities accordingly.
  - e. Ensure that seniority practices, job classifications, work assignments, and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the equal employment opportunity policy and the contractor's obligations under these specifications are being carried out.
7. Contractors are encouraged to participate in voluntary associations that assist in fulfilling their equal employment opportunity obligations. The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under these specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on equal employment opportunity in the industry, ensures that the concrete benefits of the program are reflected in the contractor's workforce participation, and can provide access to documentation that demonstrates the effectiveness of actions taken on behalf of the contractor. The obligation to comply, however, is the contractor's.
  8. The contractor is required to provide equal employment opportunity for all persons. Consequently, the contractor may be in violation of the Fair Employment and Housing Act (Government Code section 12990 et seq.) if a particular group is employed in a substantially disparate manner.
  9. The contractor shall not use the nondiscrimination standards to discriminate against any person because race, religious creed, color, national origin, ancestry, physical disability, mental disability, medical condition, genetic information, marital status, sex, gender, gender identity, gender expression, age, sexual orientation, or military and veteran status.
  10. The contractor shall not enter into any subcontract with any person or firm decertified from state contracts pursuant to Government Code section 12990.
  11. The contractor shall carry out such sanctions and penalties for violation of these specifications and the nondiscrimination clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Government Code section 12990 and its implementing regulations by the awarding agency. Any contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Government Code section 12990.
  12. The contractor shall designate a responsible official to monitor all employment related activity to ensure that the company equal employment opportunity policy is being carried out, to submit reports relating to the provisions hereof as may be required by OCP and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, status, (e.g., mechanic, apprentice trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in any easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

**Add to the end of the 2nd sentence in the 1st paragraph of section 7-1.02K(1):**

, and hauling and delivery of ready-mixed concrete.

04-22-16



**Add between the 4th and 5th paragraphs of section 7-1.02K(3):**

04-22-16

Submitted certified payrolls for hauling and delivering ready-mixed concrete must be accompanied by a written time record. The time record must include:

1. Truck driver's full name and address
2. Name and address of the factory or batching plant
3. Time the concrete was loaded at the factory or batching plant
4. Time the truck returned to the factory or batching plant
5. Truck driver's signature certifying under penalty of perjury that the information contained in this written time record is true and correct

**Add between the 9th and 10th paragraphs of section 7-1.03:**

07-15-16

If a height differential of more than 0.04 foot is created by construction activities at a joint transverse to the direction of traffic on the traveled way or a shoulder subject to public traffic, construct a temporary taper at the joint with a slope complying with the requirements shown in the following table:

**Temporary Tapers**

Height differential (foot)	Slope (horizontal:vertical)	
	Taper use of 14 days or less	Taper use of more than 14 days
Greater than 0.08	100:1 or flatter	200:1 or flatter
0.04–0.08	70:1 or flatter	70:1 or flatter

For a taper on existing asphalt concrete or concrete pavement, construct the taper with minor HMA under section 39-2.07.

Grind existing surfaces to accommodate a minimum taper thickness of 0.10 foot under either of the following conditions:

1. HMA material such as rubberized HMA, polymer-modified bonded wearing course, or open-graded friction course is unsuitable for raking to a maximum 0.02 foot thickness at the edge
2. Taper will be in place for more than 14 days

For a taper on a bridge deck or approach slab, construct the taper with polyester concrete under section 60-3.04B.

The completed surface of the taper must be uniform and must not vary more than 0.02 foot from the lower edge of a 12-foot straightedge when placed on its surface parallel and perpendicular to traffic.

If authorized, you may use alternative materials or methods to construct the required taper.

**Replace § 337.15 in the 3rd item in the list in the paragraph of section 7-1.06B with:**

05-06-16

§ 337.1

**Add between the 1st and 2nd paragraphs of section 7-1.11A:**

02-12-16

Comply with 46 CFR 381.7(a)–(b).

AA



Conduct the status check with the Engineer and an electrical representative from the traffic operations office of the district in which the work is located. The Department provides you a list of the preconstruction operational status-check results, including:

1. Existing traffic management system elements and their locations within the project limits
2. Fully functioning elements
3. Nonoperational elements

Before Contract acceptance, conduct a postconstruction operational status check of all elements shown on the list with the Engineer and an electrical representative from the traffic operations office of the district in which the work is located.

**Replace 10-3 of section 10 with:**

**10-2-10-3 RESERVED**

04-15-16

AA

## 12 TEMPORARY TRAFFIC CONTROL

07-15-16

**Replace section 12-3.32 with:**

04-15-16

### **12-3.32 PORTABLE CHANGEABLE MESSAGE SIGNS**

#### **12-3.32A General**

##### **12-3.32A(1) Summary**

Section 12-3.32A includes specifications for placing portable changeable message signs.

##### **12-3.32A(2) Definitions**

Reserved

##### **12-3.32A(3) Submittals**

If requested, submit a certificate of compliance for each PCMS.

Submit your cell phone number before starting the first activity that requires a PCMS.

##### **12-3.32A(4) Quality Assurance**

Reserved

#### **12-3.32B Materials**

Each PCMS must have a message board, controller unit, power supply, and a structural support system. The unit must be assembled to form a complete self-contained PCMS that can be delivered to the job site and placed into immediate operation. The sign unit must be capable of operating at an ambient air temperature from -4 to 158 degrees F and must be unaffected by mobile radio transmissions other than those required to control the PCMS.

A PCMS must be permanently mounted on a trailer, truck bed, or truck cab under the manufacturer's instructions. The PCMS must be securely mounted on the support vehicle such that it remains attached during any impact to the vehicle. If it is mounted on a trailer, the trailer must be capable of being leveled and plumbed.

A minimum of 3 feet of retroreflective material must be permanently affixed on all 4 sides of the trailer. The retroreflective material need not be continuous but must be visible on the same plane.

The sign panel must be capable of displaying a 3-line message with at least 7 characters per line. The characters must be at least 18 inches in height where the useable shoulder area is at least 15 feet wide.

To prevent encroachment onto the traveled way where the useable shoulder area is less than 15 feet wide, you may use a smaller message panel with at least 12-inch-high characters.

The message displayed on the sign must be visible from a distance of 1,500 feet and legible from a distance of 750 feet at noon on a cloudless day and during the night by persons with 20/20 vision or vision corrected to 20/20.

The characters on a sign panel may be 10 inches in height if:

1. PCMS is mounted on a service patrol truck or other incident response vehicle or used for traffic control operations on a highway facility where the posted speed limit is less than 40 mph
2. Message is legible from a distance of at least 650 feet at noon on a cloudless day and during the night by persons with 20/20 vision or vision corrected to 20/20

A matrix sign must provide a complete alphanumeric selection.

A PCMS must automatically adjust its brightness under varying light conditions to maintain the legibility of the message. The sign must be equipped with an automatic-dimming mode that automatically compensates for the influence of temporary light sources or abnormal lighting conditions. The sign must have 3 or more manual dimming modes of different intensities.

During the hours of darkness, a matrix sign not using lamps must be either internally or externally illuminated.

The controller must be an all solid-state unit containing the necessary circuitry for the storage of at least 5 preprogrammed messages. The controller must be installed at a location that allows the operator to perform all functions from a single position. The controller must have a keyboard entry system that allows the operator to generate an infinite number of additional messages in addition to the preprogrammed stored messages. The keyboard must be equipped with a security lockout feature to prevent unauthorized use of the controller.

The controller must have:

1. Nonvolatile memory that stores keyboard-created messages during periods when the power is not activated
2. Variable display rate that allows the operator to match the information display to the speed of approaching traffic
3. Screen upon which messages may be reviewed before being displayed on the sign

The flashing-off time must be adjustable from within the control cabinet.

### **12-3.32C Construction**

Place a PCMS as far from the traveled way as practicable where it is legible to approaching traffic without encroaching on the traveled way. Where the vertical roadway curvature restricts the sight distance of approaching traffic, place the sign on or before the crest of the curvature where it is most visible to the approaching traffic. Where the horizontal roadway curvature restricts the sight distance of approaching traffic, place the sign at or before the curve where it is most visible to approaching traffic. Where practicable, place the sign behind guardrail or Type K temporary railing.

Make a taper consisting of 9 traffic cones placed 25 feet apart to delineate the location of a PCMS except where the sign is placed behind guardrail or Type K temporary railing.

When in full operation, the bottom of a sign must be at least 7 feet above the roadway in areas where pedestrians are anticipated and 5 feet above the roadway elsewhere, and the top of the sign must be not more than 14.5 feet above the roadway.

Operate the PCMS under the manufacturer's instructions.

Keep the PCMS clean to provide maximum visibility.

If multiple signs are needed, place each sign on the same side of the road at least 1,000 feet apart on freeways and expressways and at least 500 feet apart on other types of highways.

If more than one PCMS is simultaneously visible to traffic, only 1 sign may display a sequential message at any time. Do not use dynamic message displays, such as animation, rapid flashing, dissolving, exploding, scrolling, horizontal movement, or vertical movement of messages. The message must be centered within each line of the display.

You may use an additional PCMS if more than 2 phases are needed to display a message.

Display only messages shown or ordered.

Repeat the entire message continuously in not more than 2 phases of at least 3 seconds per phase. The sum of the display times for both of the phases must be a maximum of 8 seconds. If more than 2 phases are needed to display a message, use an additional PCMS.

You must be available by cell phone during activities that require a sign. Be prepared to immediately change the displayed message if ordered. You may operate the sign with a 24-hour timer control or remote control if authorized.

After the initial placement, move a sign from location to location as ordered.

When a PCMS is not in use, move it to an area at least 15 feet from the edge of the traveled way or remove it from the job site away from traffic.

### **12-3.32D Payment**

Not Used

### **Add between the 1st sentence and 2nd sentences in the 1st paragraph of section 12-4.02A(3)(a):**

07-15-16

For a project in District 7, submit the request at least 15 days before the proposed closure date.

### **Replace section 12-4.02C(2) with:**

01-15-16

#### **12-4.02C(2) Lane Closure System**

##### **12-4.02C(2)(a) General**

The Department provides LCS training. Request the LCS training at least 30 days before submitting the 1st closure request. The Department provides the training within 15 days after your request.

LCS training is web-based or held at a time and location agreed upon by you and the Engineer. For web-based training, the Engineer provides you the website address to access the training.

With 5 business days after completion of the training, the Department provides LCS accounts and user IDs to your assigned, trained representatives.

Each representative must maintain a unique password and current user information in the LCS.

04-15-16

The project is not accessible in LCS after Contract acceptance.

01-15-16

##### **12-4.02C(2)(b) Status Updates for Authorized Closures**

Update the status of authorized closures using the LCS Mobile web page.

For a stationary closure, use code:

1. 10-97 immediately before you place the 1st advance warning sign
2. 10-98 immediately after you remove all of the advance warning signs

For a moving closure, use code:

1. 10-97 immediately before the actual start time of the closure
2. 10-98 immediately after the actual end time of the closure

Cancel an authorized closure by using code 10-22 within 2 hours after the authorized start time.

If you are unable to access the LCS Mobile web page, immediately notify the Engineer of the closure's status.

**Replace the 1st sentence in the 3rd paragraph of section 12-6.03A with:**

07-15-16

When the Engineer determines the temporary pavement delineation is no longer required for the direction of traffic, remove the temporary pavement delineation, including any underlying adhesive for temporary pavement markers, from the final layer of surfacing and from the pavement to remain in place.

^^

**13 WATER POLLUTION CONTROL**

09-02-16

**Replace *General Industrial Permit* in the 2nd item in the list in the paragraph of section 13-1.01C(3) with:**

05-06-16

Industrial General Permit

**Replace the 2nd paragraph of section 13-1.01D(2) with:**

05-06-16

Discharges from manufacturing facilities, such as batch plants and crushing plants, must comply with the discharge requirements in the NPDES General Permit for Storm Water Discharges Associated with Industrial Activities; Order No. 2014-0057-DWQ, CAS000001 (Industrial General Permit), issued by the SWRCB. For the Industrial General Permit, go to the SWRCB website.

**Replace *General Industrial Permit* in the 3rd paragraph of section 13-1.01D(2) with:**

05-06-16

Industrial General Permit

**Replace the 2nd paragraph of section 13-3.01D(2) with:**

09-02-16

For a project in the Lake Tahoe Hydrologic Unit, discharges of stormwater from the project must comply with the NPDES General Permit for General Waste Discharge Requirements and National Pollutant Discharge Elimination System General Permit for Storm Water Discharges Associated with Construction Activity in the Lake Tahoe Hydrologic Unit, Counties of Alpine, El Dorado, and Placer, (Order No. R6T-2016-0010 and NPDES No. CAG616002). You may view the General Permit for the Lake Tahoe Hydrologic Unit at the Construction Storm Water Program page of the SWRCB website.

**Replace the 2nd paragraph of section 13-8.01D(2) with:**

09-02-16

For a project within the Lake Tahoe Hydrologic Unit, the design, installation, operation, and monitoring of the temporary ATS and monitoring of the treated effluent must comply with Attachment E of the NPDES General Permit for General Waste Discharge Requirements and National Pollutant Discharge Elimination System General Permit for Storm Water Discharges Associated with Construction Activity in the Lake Tahoe Hydrologic Unit, Counties of Alpine, El Dorado, and Placer, (Order No. R6T-2016-0010 and NPDES No. CAG616002). You may view the General Permit for the Lake Tahoe Hydrologic Unit at the Construction Storm Water Program page of the SWRCB website.

AA

**16 TEMPORARY FACILITIES**

04-15-16

**Add between the 1st and 2nd sentences of section 16-2.03A(1):**

04-15-16

Constructing a high-visibility fence includes the installation of any signs specified in the special provisions.

AA

**DIVISION III EARTHWORK AND LANDSCAPE**

**20 LANDSCAPE**

07-15-16

**Replace 86 in the 1st paragraph of section 20-2.01C(2) with:**

04-15-16

87

**Replace the 8th paragraph of section 20-2.01C(2) with:**

07-15-16

Trenches for irrigation supply lines and conduits 3 inches and larger in diameter must be a minimum of 18 inches below the finished grade, measured to the top of the installed pipe.

**Replace 86 in the 1st paragraph of section 20-2.01C(3) with:**

04-15-16

87

**Replace section 20-2.04A(4) with:**

04-15-16

Perform conductors test. The test must comply with the specifications in section 87.

Where the conductors are installed by trenching and backfilling, perform the test after a minimum of 6 inches of backfill material has been placed and compacted over the conductors.

**Replace the 1st paragraph of section 20-2.04C(4) with:**

04-15-16

Splice low voltage control and neutral conductors under section 87, except do not use Method B.

**Replace the 3rd paragraph of section 20-2.05B with:**

07-15-16

The impeller must be glass reinforced nylon on a tungsten carbide shaft.

**Replace 86 in the 2nd paragraph of section 20-2.06C with:**

04-15-16

87

**Replace section 20-2.07B(5) with:**

04-15-16

**20-2.07B(5) PVC Pipe Conduit Sleeve**

PVC pipe conduit sleeves must be schedule 40 complying with ASTM D1785.

Fittings must be schedule 80.

**Replace section 20-2.07C(3) with:**

04-15-16

**20-2.07C(3) PVC Pipe Conduit Sleeve**

Where PVC pipe conduit sleeves 2 inches or less in outside diameter is installed under surfacing, you may install by directional boring under section 20-2.07C(2)(b).

For sleeves 2 inches or less in diameter, the top of the conduit must be a minimum of 18 inches below surfacing.

Extend sleeves 6 inches beyond surfacing. Cap ends of conduit until used.

**Replace sections 20-2.09B and 20-2.09C with:**

07-15-16

**20-2.09B Materials**

**20-2.09B(1) General**

Swing joints must match the inlet connection size of the riser.

Where shown, a sprinkler assembly must include a check valve.

Threaded nipples for swing joints and risers must be schedule 80, PVC 1120 or PVC 1220 pipe, and comply with ASTM D1785. Risers for sprinkler assemblies must be UV resistant.

Fittings for sprinkler assemblies must be injection-molded PVC, schedule 40, and comply with ASTM D2466.

Flexible hose for sprinkler assemblies must be leak-free, non-rigid and comply with ASTM D2287, cell Type 6564500. The hose must comply with ASTM D2122 and have the thickness shown in the following table:

Nominal hose diameter (inch)	Minimum wall thickness (inch)
1/2	0.127
3/4	0.154
1	0.179

Solvent cement and fittings for flexible hose must comply with section 20-2.08B(5).

**20-2.09B(2) Pop-Up Sprinkler Assemblies**

Each pop-up sprinkler assembly must include a body, nozzle, swing joint, pressure reducing device, fittings, and sprinkler protector where shown.

**20-2.09B(3) Riser Sprinkler Assemblies**

Each riser sprinkler assembly must include a body, flexible hose, threaded nipple, nozzle, swing joint (except for a Type V riser), pressure reducing device, fittings, and riser support where shown.

**20-2.09B(4) Tree Well Sprinkler Assemblies**

Each tree well sprinkler assembly must include a threaded nipple, nozzle, swing joint, fittings, perforated drainpipe, and drain grate.



The perforated drainpipe must be commercial-grade, rigid PVC pipe with holes spaced not more than 6 inches on center on 1 side of the pipe.

The drain grate must be a commercially-available, 1-piece, injection-molded grate manufactured from structural foam polyolefins with UV light inhibitors. Drain grate must be black.

Gravel for filling the drainpipe must be graded such that 100 percent passes the 3/4-inch sieve and 100 percent is retained on the 1/2-inch sieve. The gravel must be clean, washed, dry, and free from clay or organic material.

#### **20-2.09C Construction**

Where shown, install a flow shut-off device under the manufacturer's instructions, unless you use equipment with a preinstalled flow shut-off device.

Where shown, install a pressure reducing device under the manufacturer's instructions, unless you use equipment with a preinstalled pressure reducing device.

Install pop-up and riser sprinkler assembly:

1. From 6-1/2 to 8 feet from curbs, dikes, and sidewalks
2. At least 10 feet from paved shoulders
3. At least 3 feet from fences and walls

If sprinkler assembly cannot be installed within these limits, the location will be determined by the Engineer.

Set sprinkler assembly riser on slopes perpendicular to the plane of the slope.

#### **Replace the paragraph of section 20-2.10B(3) with:**

07-15-16

Each check valve must be one of the following:

1. Schedule 80 PVC with a factory setting to withstand a minimum 7-foot head on risers
2. Class 200 PVC if used on a nonpressurized plastic irrigation supply line
3. Internal to the sprinkler body with a factory setting to withstand a minimum 7-foot head

#### **Replace the paragraph of section 20-2.10C(3) with:**

07-15-16

Install check valves as necessary to prevent low-head drainage.

#### **Replace the paragraphs of section 20-3.01B(10) with:**

07-15-16

Each plant stake for vines must be nominal 1 by 1 inch and 18 inches long.

Each plant stake for trees must be nominal 2 by 2 inches or nominal 2 inches in diameter and long enough to keep the tree in an upright position.

#### **Replace the paragraph of section 20-3.01B(11) with:**

07-15-16

Each plant tie for vines must be extruded vinyl-based tape, 1 inch wide and at least 8 mils thick.

Each plant tie for trees must be a (1) minimum 3/4-inch-wide, UV-resistant, flexible vinyl tie complying with ASTM D412 for tensile and elongation strength, or (2) lock-stitch, woven polypropylene with a minimum 900 lb tensile strength.

**Add between the 7th and 8th paragraphs of section 20-3.02C(3)(b):**

07-15-16

Spread the vine shoots and tie them with a plant tie to each stake above the crossing point.

**Replace the 8th paragraph of section 20-3.02C(3)(b) with:**

07-15-16

Tie trees to the stakes with 2 tree ties, 1 tie to each stake. Each tie must form a figure eight by crossing the tie between the tree and the stake. Install ties at the lowest position that will support the tree in an upright position. Install the ties such that they provide trunk flexibility but do not allow the trunk to rub against the stakes. Wrap each end of the tie 1-1/2 turns around the stake and securely tie or nail it to the stake.

**Replace the 1st paragraph of section 20-5.02C(1) with:**

07-15-16

Where edging is used to delineate the limits of inert ground cover or wood mulch areas, install the edging before installing the inert ground cover or wood mulch.

**Delete *AND MULCHES* in the heading of section 20-5.03.**

07-15-16

**Delete *and mulches* in the paragraph of section 20-5.03A(1)(a).**

07-15-16

**Replace the paragraph of section 20-5.03A(3)(a) with:**

07-15-16

Before installing inert ground cover, remove plants and weeds to the ground level.

**Delete *or mulch* at each occurrence in sections 20-5.03A(3)(c) and 20-5.03A(3)(d).**

07-15-16

**Replace section 20-5.03E with:**

07-15-16

**20-5.03E Reserved**

**Replace section 20-5.04 with:**

07-15-16

**20-5.04 WOOD MULCH**

**20-5.04A General**

**20-5.04A(1) Summary**

Section 20-5.04 includes specifications for placing wood mulch.

**20-5.04A(2) Definitions**

Reserved

**20-5.04A(3) Submittals**

Submit a certificate of compliance for wood mulch.

Submit a 2 cu ft mulch sample with the mulch source shown on the bag. Obtain authorization before delivering the mulch to the job site.

**20-5.04A(4) Quality Assurance**

Reserved

## **20-5.04B Materials**

### **20-5.04B(1) General**

Mulch must not contain more than 0.1 percent of deleterious materials such as rocks, glass, plastics, metals, clods, weeds, weed seeds, coarse objects, sticks larger than the specified particle size, salts, paint, petroleum products, pesticides or chemical residues harmful to plant or animal life.

### **20-5.04B(2) Tree Bark Mulch**

Tree bark mulch must be derived from cedar, Douglas fir, or redwood species.

The mulch must be ground such that at least 95 percent of the material by volume is less than 2 inches long in any dimension and no more than 30 percent by volume is less than 1 inch long in any dimension.

### **20-5.04B(3) Wood Chip Mulch**

Wood chip mulch must:

1. Be derived from clean wood
2. Not contain leaves or small twigs
3. Contain at least 95 percent by volume of wood chips with a width and thickness from 1/16 to 3/8 inch and a length from 1/2 to 3 inches

### **20-5.04B(4) Shredded Bark Mulch**

Shredded bark mulch must:

1. Be derived from trees
2. Be a blend of loose, long, thin wood, or bark pieces
3. Contain at least 95 percent by volume of wood strands with a width and thickness from 1/8 to 1-1/2 inches and a length from 2 to 8 inches

### **20-5.04B(5) Tree Trimming Mulch**

Tree trimming mulch must:

1. Be derived from chipped trees and may contain leaves and small twigs
2. Contain at least 95 percent by volume of material less than 3 inches long for any dimension and not more than 30 percent by volume of material less than 1 inch long for any dimension

### **20-5.04B(6)–20-5.04B(11) Reserved**

### **20-5.04C Construction**

Before placing wood mulch, remove plants and weeds to the ground level.

Maintain the planned flow lines, slope gradients, and contours of the job site. Grade the subgrade to a smooth and uniform surface.

Place mulch after the plants have been planted.

Place mulch in the plant basin at the rate described. Mulch must not come in contact with the plant crown and stem.

Place mulch as shown in areas outside of plant basins to a uniform thickness.

Spread mulch from the outside edge of the plant basin to the adjacent edges of shoulders, paving, retaining walls, dikes, edging, curbs, sidewalks, walls, fences, and existing plantings. If the plant is 12 feet or more from the adjacent edges of any of these elements, spread the mulch 6 feet beyond the outside edge of the plant basin.

Do not place mulch within 4 feet of:

1. Flow line of earthen drainage ditches
2. Edge of paved ditches
3. Drainage flow lines

**20-5.04D Payment**

The payment quantity for wood mulch is the volume measured in the vehicle at the point of delivery.

^^

**21 EROSION CONTROL**

07-15-16

**Add between *tube* and 12 in the 1st paragraph of section 21-2.02Q:**

8 or

07-15-16

^^

**DIVISION IV SUBBASES AND BASES**

**23 GENERAL**

07-15-16

**Replace the headings and paragraphs in section 23 with:**

07-15-16

**23-1 GENERAL**

**23-1.01 GENERAL**

**23-1.01A Summary**

Section 23 includes general specifications for constructing subbases and bases.

**23-1.01B Definitions**

Reserved

**23-1.01C Submittals**

Submit a QC plan for the types of subbases or bases where described.

**23-1.01D Quality Assurance**

**23-1.01D(1) General**

**23-1.01D(1)(a) General**

Take samples under California Test 125.

**23-1.01D(1)(b) Test Result Disputes**

You and the Engineer must work together to avoid potential conflicts and to resolve disputes regarding test result discrepancies. Notify the Engineer within 5 business days of receiving the test result if you dispute the test result.

If you or the Engineer dispute each other's test results, submit your test results and copies of paperwork including worksheets used to determine the disputed test results. An independent third party performs referee testing. Before the independent third party participates in a dispute resolution, it must be qualified under AASHTO Materials Reference Laboratory program and the Department's Independent Assurance Program. The independent third party must have no prior direct involvement with this Contract. By mutual agreement, the independent third party is chosen from:

1. Department laboratory in a district or region not in the district or region the project is located
2. Transportation Laboratory
3. Laboratory not currently employed by you or your material producer

If split acceptance samples are not available, the independent third party uses any available material representing the disputed material for evaluation.

If the independent third party determines the Department's test results are valid, the Engineer deducts the independent third party testing costs from payments. If the independent third party determines your test results are valid, the Department pays the independent third party testing costs.

**23-1.01D(2) Quality Control**

**23-1.01D(2)(a) General**

Provide a QC manager when the quantity of subbase or base is as shown in the following table:

<b>QC Manager Requirements</b>	
Subbase or base	Requirement
Stabilized soil (sq yd)	≥ 20,000
Aggregate subbases (cu yd)	≥ 20,000
Aggregate bases (cu yd)	≥ 20,000
CTB (cu yd)	≥ 10,000
Lean concrete base (cu yd)	≥ 2,000
Rapid strength concrete base (cu yd)	≥ 1,000
Lean concrete base rapid setting (cu yd)	≥ 1,000
Concrete base (cu yd)	≥ 1,000
Treated permeable bases (cu yd)	≥ 2,000
Reclaimed pavements (sq yd)	≥ 10,000

Provide a testing laboratory to perform quality control tests. Maintain sampling and testing equipment in proper working condition.

You are not entitled to compensation for the suspension of work resulting from noncompliance with quality control requirements, including those identified within the QC plan.

**23-1.01D(2)(b) Quality Control Plan**

The QC plan must describe the organization and procedures used to:

1. Control the production process
2. Determine if a change to the production process is needed
3. Implement a change

The QC plan must include action and suspension limits and details of corrective action to be taken if any process is outside of those limits. Suspension limits must not exceed specified acceptance criteria.

The QC plan must describe how test results will be submitted including times for sampling and testing for each quality characteristic.

**23-1.01D(2)(c) Qualifications**

Testing laboratories and testing equipment must comply with the Department's Independent Assurance Program.

Personnel performing sampling and testing must be qualified under the Department's Independent Assurance Program for the sampling and testing performed.

**23-1.01D(3) Department Acceptance**

Reserved

**23-1.02 MATERIALS**

Not Used

**23-1.03 CONSTRUCTION**

Not Used

**23-1.04 PAYMENT**

Not Used





**QC Testing Frequencies**

Quality characteristic	Test method	Sampling location	Minimum frequency
R-value	California Test 301	Stockpiles, transportation units, windrows, or roadways	1 test before beginning work and every 2000 cu yd thereafter <sup>a</sup>
Aggregate gradation	California Test 202	Stockpiles, transportation units, windrows, or roadways	1 per 500 cu yd but at least one per day of placement
Sand equivalent	California Test 217	Stockpiles, transportation units, windrows, or roadways	
Relative compaction	California Test 231	Roadway	1 per 500 sq yd on each layer

<sup>a</sup>Additional R-value frequency testing will not be required when the average of 4 consecutive sand equivalent tests is 4 or more above the specified operating range value.

**Add between the 2nd and 3rd paragraphs of section 25-1.01D(3):**

07-15-16

The Engineer takes aggregate subbase samples for R-value, aggregate gradation, and sand equivalent from any of the following locations:

1. Windrow
2. Roadway

07-15-16

**Delete for each noncompliant test result in the 4th paragraph of section 25-1.01D(3).**

07-15-16

**Delete a in the 5th paragraph of section 25-1.01D(3).**

^^

**26 AGGREGATE BASES**

07-15-16

**Replace Reserved in section 26-1.01C with:**

07-15-16

Submit an aggregate base QC plan.

**Replace Reserved in section 26-1.01D(1) with:**

07-15-16

Aggregate samples must not be treated with lime, cement, or chemicals before testing for durability index. Aggregate from untreated reclaimed processed AC, PCC, LCB, or CTB is not considered treated.



**Replace *Reserved* in section 26-1.01D(2) with:**

07-15-16

**26-1.01D(2)(a) General**

Reserved

**26-1.01D(2)(b) Quality Control Plan**

Reserved

**26-1.01D(2)(c) Qualifications**

Reserved

**26-1.01D(2)(d) Quality Control Testing**

AB quality control must include testing the quality characteristics at the frequencies shown in the following table:

**QC Testing Frequencies**

Quality characteristic	Test method	Sampling location	Minimum frequency
R-value	California Test 301	Stockpiles, transportation units, windrows, or roadways	1 test before starting work and every 2,000 cu yd thereafter <sup>a</sup>
Aggregate gradation	California Test 202	Stockpiles, transportation units, windrows, or roadways	1 per 500 cu yd but at least one per day of placement
Sand equivalent	California Test 217	Stockpiles, transportation units, windrows, or roadways	1 per project
Durability index <sup>b</sup>	California Test 229	Stockpiles, transportation units, windrows, or roadways	
Relative compaction	California Test 231	Roadway	1 per 500 sq yd on each layer

<sup>a</sup>Additional R-value frequency testing will not be required when the average of 4 consecutive sand equivalent tests is 29 or greater for Class 2 AB or 25 or greater for Class 3 AB.

<sup>b</sup>Applies if section 26-1.02 contains an applicable requirement for durability index

**Add between *requirements*, and *and* in the 1st paragraph of section 26-1.01D(3):**

07-15-16

durability,

**Add between the 2nd and 3rd paragraphs of section 26-1.01D(3):**

07-15-16

The Engineer takes aggregate base samples for R-value, aggregate gradation, sand equivalent, and durability index from any of the following locations:

1. Windrow
2. Roadway

**Delete the 3rd paragraph of section 26-1.01D(3).**

07-15-16

AA

**27 CEMENT TREATED BASES**

07-15-16

**Add to section 27-1.01C:**

Submit cement treated base QC plan.

07-15-16

**Replace the headings and paragraphs in section 27-1.01D with:**

07-15-16

**27-1.01D Quality Assurance**

**27-1.01D(1) General**

After the CTB has been spread on the subgrade and before initial compaction, the cement content of the completed mixture of CTB must not vary from the specified cement content by more than 0.6 percent of the weight of the dry aggregate when tested under California Test 338.

For Class A CTB, compaction is tested under California Test 312 or 231.

The relative compaction of CTB must be at least 95 percent. Each layer of CTB may be tested for compaction, or all layers may be tested together at the option the Engineer. If all layers are tested together, you are not relieved of the responsibility to achieve the required compaction in each layer placed.

**27-1.01D(1)(a) Aggregate**

When tested under California Test 301, aggregate for Class B CTB must have (1) an R-value of at least 60 before mixing with cement and (2) an R-value of at least 80 when aggregate is mixed with an amount of cement that does not exceed 2.5 percent by weight of the dry aggregate.

Before sand equivalent testing, aggregate samples must not be treated with lime, cement, or chemicals.

If the aggregate gradation test results, the sand equivalent test results, or both comply with contract compliance requirements but not operating range requirements, you may continue placing CTB for the remainder of the work day. Do not place additional CTB until you demonstrate to the Engineer that the CTB to be placed complies with the operating range requirements.

If the aggregate gradation test results, sand equivalent test results, or both do not comply with contract compliance requirements, remove the CTB or request a payment deduction. If your request is authorized, \$2.50/cu yd is deducted. If CTB is paid for by weight, the Engineer converts tons to cubic yards for the purpose of reducing payment for noncompliant CTB left in place. An aggregate gradation and a sand equivalent test represents up to (1) 500 cu yd or (2) 1 day's production if less than 500 cu yd.

**27-1.01D(1)(b) Road-Mixed Cement Treated Base Moisture Content**

Just before initial compaction the moisture content of the completed mixture must be at least the optimum moisture content less 1 percent. The moisture content is determined under California Test 226 and optimum moisture content is determined under California Test 312.

**27-1.01D(1)(c) Plant-Mixed Cement Treated Base Moisture Content**

At the point of delivery to the work, the moisture content of the completed mixture must be at least the optimum moisture content less 1 percent. The moisture content is determined under California Test 226 and optimum moisture content under California Test 312.

**27-1.01D(2) Quality Control**

**27-1.01D(2)(a) General**

Reserved

**27-1.01D(2)(b) Quality Control Plan**

Reserved

**27-1.01D(2)(c) Qualifications**

Reserved

**27-1.01D(2)(d) Quality Control Testing**

CTB quality control must include testing the quality characteristics at the frequencies shown in the following table:

**QC Testing Frequencies**

Quality characteristic	Test method	Sampling location	Minimum frequency
Aggregate gradation	California Test 202 modified	Stockpiles, plant, transportation units, windrow, or roadway	1 per 500 cu yd but at least one per day of placement
Sand equivalent	California Test 217	Stockpiles, plant, transportation units, windrow, or roadway	
R-value <sup>a</sup>	California Test 301	Stockpiles, plant, transportation units, windrows, or roadway	1 test before starting work and every 2000 cu yd thereafter <sup>b</sup>
Optimum moisture content	California Test 312	Plant, transportation units, windrow, or roadway	1 per day of placement
Moisture content	California Test 226	Roadway	1 per 500 cu yd but at least one per day of placement
Cement content	California Test 338	Windrows or roadway	1 per 1000 cu yd but at least one per day of placement
Relative compaction	California Test 312 or 231	Roadway	1 per 2000 sq yd but at least one per day of placement
Compressive strength <sup>c</sup>	California Test 312	Windrow or roadways	1 per day of placement

<sup>a</sup>R-value is required for Class B CTB only

<sup>b</sup>Additional R-value frequency testing will not be required while the average of 4 consecutive sand equivalent tests is 4 or more above the specified operating range value.

<sup>c</sup>Compressive strength is required for Class A CTB only when specified

**27-1.01D(3) Department Acceptance**

The Department's acceptance testing includes testing the CTB quality characteristics shown in the following table:

**CTB Requirements for Acceptance**

Quality characteristic	Test method
Aggregate gradation	California Test 202 modified
Sand equivalent	California Test 217
R-value <sup>a</sup>	California Test 301
Optimum moisture content	California Test 312
Moisture content	California Test 226
Cement content	California Test 338
Relative compaction	California Test 312 or 231
Compressive strength <sup>b</sup>	California Test 312

<sup>a</sup>R-value is required for Class B CTB only

<sup>b</sup>Compressive strength is required for Class A CTB only when specified

The Engineer takes samples for aggregate gradation and sand equivalent from any of the following locations:

1. Plant



**Replace the headings and paragraphs in section 28-2.01D with:**

07-15-16

**28-2.01D Quality Assurance**

**28-2.01D(1) General**

**28-2.01D(1)(a) General**

The molds for compressive strength testing under ASTM C31 or ASTM C192 must be 6 by 12 inches.

If the aggregate gradation test results, sand equivalent test results or both comply with the contract compliance requirements but not the operating range requirements, you may continue placing LCB for the remainder of the work day. Do not place additional LCB until you demonstrate the LCB to be placed complies with the operating range requirements.

**28-2.01D(1)(b) Qualifications**

Field qualification tests and calculations must be performed by an ACI certified "Concrete Laboratory Technician, Grade I.

**28-2.01D(1)(c) Aggregate Qualification Testing**

Qualify the aggregate for each proposed aggregate source and gradation. The qualification tests include (1) a sand equivalent and (2) an average 7-day compressive strength under ASTM C39 of 3 cylinders manufactured under ASTM C192 except cure cylinders in molds without lids after initial curing.

For the compressive strength test, the cement content for each cylinder must be 300 lb/cu yd. The 7-day average compressive strength must be at least 610 psi. The cement must be Type II portland cement.

LCB must have from 3 to 4 percent air content during aggregate qualification testing.

**28-2.01D(1)(d) Field Qualification Testing**

Before placing LCB, you must perform field qualification testing and obtain authorization for each mix design. Retest and obtain authorization for changes to the authorized mix designs.

Notify the Engineer at least 5 business days before field qualification. Perform the field qualification at the job site or an authorized location.

Field qualification testing includes tests for compressive strength, air content, and penetration or slump.

For compressive strength field qualification testing:

1. Prepare 12 cylinders under ASTM C31 except final cure cylinders in molds without lids from a single batch.
2. Perform 3 tests; each test consists of determining the average compressive strength of 2 cylinders at 7 days under ASTM C39. The average compressive strength for each test must be at least 530 psi

If you submitted a notice to produce LCB qualifying for a transverse contraction joint waiver, manufacture additional specimens and test the LCB for compressive strength at 3 days. Prepare the compressive strength cylinders under ASTM C31 except final cure cylinders in molds without lids at the same time using the same material and procedures as the 7-day compressive strength cylinders except do not submit 6 additional test cylinders. The average 3-day compressive strength for each test must be not more than 500 psi.

**28-2.01D(2) Quality Control**

**28-2.01D(2)(a) General**

Reserved

**28-2.01D(2)(b) Quality Control Manager**

Reserved

**28-2.01D(2)(c) Quality Control Testing**

Test the LCB under the test methods and at the locations and frequencies shown in the following table:

**LCB Sampling Location and Testing Frequencies**

Quality characteristic	Test method	Sampling location	Minimum sampling and testing frequency
Sand equivalent	ASTM D2419	Source	1 per 500 cubic yards but at least 1 per day of production
Aggregate gradation	ASTM C136		
Air content	ASTM C231	Job site	
Penetration <sup>a</sup>	ASTM C360		
Slump <sup>a</sup>	ASTM C143		
Compressive strength	ASTM C39 <sup>b</sup>		

<sup>a</sup>Test for either penetration or slump

<sup>b</sup>Prepare cylinders under ASTM C31 except final cure cylinders in molds without lids.

**28-2.01D(3) Department Acceptance**

The Department accepts LCB based on compliance with the requirements shown in the following table:

**LCB Requirements for Acceptance**

Quality characteristic	Test method	Requirement
Compressive strength (min, psi at 7 days)	ASTM C39 <sup>a</sup>	530 <sup>b</sup>

<sup>a</sup>Cylinders prepared under ASTM C31 except final cure cylinders in molds without lids.

<sup>b</sup>A compressive strength test represents up to (1) 1,000 cu yd or (2) 1 day's production if less than 1,000 cu yd.

**Replace section 28-2.01D(4) in item 3 of the 5th paragraph in section 28-2.03D with:**

07-15-16

section 28-2.01D(1)(c)

**Replace the 1st paragraph in section 28-2.03F with:**

07-15-16

After finishing LCB, cure LCB with pigmented curing compound under section 90-1.03B(3) and 40-1.03I. Apply curing compound:

1. In 2 separate applications
2. Before the atmospheric temperature falls below 40 degrees F
3. At a rate of 1 gal/150 sq ft for the first application
4. At a rate of 1 gal/200 sq ft for the second application

**Replace *Reserved* in section 28-3.01C(3) with:**

07-15-16

Submit a rapid strength concrete base QC plan.

**Replace the headings and paragraphs in section 28-3.01D with:**

07-15-16

**28-3.01D Quality Assurance**

**28-3.01D(1) General**

**28-3.01D(1)(a) General**

At the preconstruction meeting be prepared to discuss the project specifications and methods of performing each item of work. Items discussed must include the processes for:

1. Production
2. Transportation

3. Placement
4. QC plan, if specified in the special provisions
5. Contingency plan
6. QC sampling and testing
7. Acceptance criteria

Beams for modulus of rupture testing must be fabricated and tested under California Test 524. The beams may be fabricated using an internal vibrator under ASTM C31. For each test, 3 beam must be fabricated and the test results averaged. No single test represents more than that day's production or 130 cu yd, whichever is less.

For early age testing, beams must be cured so the monitored temperatures in the beams and the test strip are always within 5 degrees F. The internal temperatures of the RSC base and early age beams must be monitored and recorded at intervals of at least 5 minutes. Thermocouples or thermistors connected to strip-chart recorders or digital data loggers must be installed to monitor the temperatures. Temperature recording devices must be accurate to within  $\pm 2$  degrees F. Until early age testing is completed, internal temperatures must be measured at 1 inch from the top, 1 inch from the bottom, and no closer than 3 inches from any edge.

For other age testing, beams must be cured under California Test 524 except beams must be placed into sand at a time that is the earlier of either from 5 to 10 times the final set time, or 24 hours.

RSC base must have an opening age modulus of rupture of not less than 400 psi and a 7-day modulus of rupture of not less than 600 psi.

**28-3.01D(1)(b) Preconstruction Meeting**

Reserved

**28-3.01D(1)(c) Test Strip**

Reserved

**28-3.01D(2) Quality Control**

**28-3.01D(2)(a) General**

Reserved

**28-3.01D(2)(b) Quality Control Manager**

Reserved

**28-3.01D(2)(c) Quality Control Testing**

Test the rapid strength concrete base under the test methods and at the locations and frequencies shown in the following table:

**Rapid Strength Concrete Base Sampling Location and Testing Frequencies**

Quality characteristic	Test method	Sample Location	Minimum testing frequency <sup>a</sup>
Cleanness value	California Test 227	Source	1 per 500 cubic yards but at least 1 per shift
Sand equivalent	California Test 217		
Aggregate gradation	California Test 202		
Air content	California Test 504	Job site	1 per 130 cu yd but at least 1 per shift
Yield	California Test 518		1 per shift
Slump or penetration	ASTM C143 or California Test 533		1 per 2 hours of placement
Density	California Test 518		1 per shift
Aggregate moisture meter calibration <sup>b</sup>	California Test 223 or California Test 226		1 per shift
Modulus of rupture	California Test 524		1 per 130 cu yd but at least 1 per shift

<sup>a</sup>Test at the most frequent interval.

<sup>b</sup>Check calibration of the plant moisture meter by comparing moisture meter readings with California Test 223 or California Test 226 test results.

Notify the Engineer at least 2 business days before any sampling and testing. Submit testing results within 15 minutes of testing completion. Record inspection, sampling, and testing on the forms accepted with the QC plan and submit them within 48 hours of completion of each day of production and within 24 hours of 7-day modulus of rupture tests.

During the placement of RSC base, fabricate beams and test for the modulus of rupture:

1. At opening age
2. At 7 days after placing the first 30 cu yd
3. At least once every 130 cu yd
4. Within the final truckload

Opening age tests must be performed in the presence of the Engineer.

**28-3.01D(3) Department Acceptance**

The Department accepts RSC base based on compliance with the requirements shown in the following table:

**RSC Base Requirements for Acceptance**

Quality characteristic	Test method	Requirement
Modulus of rupture (min, psi at 7 days)	California Test 524	600

The Engineer adjust payment for RSC base for the 7-day modulus of rupture as follows:

1. Payment for a base with a modulus of rupture of 600 psi or greater is not adjusted.
2. Payment for a base with a modulus of rupture of less than 600 and greater than or equal to 550 psi is reduced by 5 percent.
3. Payment for a base with a modulus of rupture of less than 550 and greater than or equal to 500 psi is reduced by 10 percent.
4. Payment for a base with a modulus of rupture of less than 500 psi is not adjusted and no payment is made. Remove and replace this base.

**Add to section 28-4.01C(1):**

Submit a lean concrete base rapid setting QC plan.

07-15-16



**Replace the headings and paragraphs in section 28-4.01D with:**

07-15-16

**28-4.01D Quality Assurance**

**28-4.01D(1) General**

**28-4.01D(1)(a) General**

For compressive strength testing, prepare 6 cylinders under California Test 540. Test cylinders must be 6 by 12 inches. As an alternative to rodding, a vibrator may be used under California Test 524. Test cylinders under California Test 521 and perform 3 tests with each test consisting of 2 cylinders. The test result is the average from the 2 cylinders.

**28-4.01D(1)(b) Field Qualification**

Before placing lean concrete base rapid setting, you must perform field qualification testing and obtain authorization for each mix design. Retest and obtain authorization for changes to authorized mixed designs.

Proposed mix designs must be field qualified before you place the base represented by those mix designs. The technician performing the field test must hold current ACI certification as a Concrete Field Testing Technician-Grade I.

Notify the Engineer at least 5 days before field qualification. Perform field qualification within the job site or a location authorized.

Field qualification testing includes compressive strength, air content, and penetration or slump in compliance with the table titled "Lean Concrete Base Rapid Setting Requirements."

Field qualification must comply with the following:

1. Test for compressive strength at opening age and 7 days of age
2. At opening age, the compressive strength for each test must be at least 180 psi and the average strength for the 3 tests must be at least 200 psi
3. At 7 days age, the compressive strength for each test must be at least 600 psi and the average strength for the 3 tests must be at least 725 psi

**28-4.01D(2) Quality Control**

**28-4.01D(2)(a) General**

Reserved

**28-4.01D(2)(b) Quality Control Manager**

Reserved

**28-4.01D(2)(c) Quality Control Testing**

Test the base under the test methods and at the locations and frequencies shown in the following table:

**LCB Rapid Setting Sampling Location and Testing Frequencies**

Quality characteristic	Test method	Sampling location	Minimum sampling and testing frequency
Sand equivalent	ASTM D2419	Source	1 per 500 cu yd, minimum 1 per day of production
Aggregate gradation	ASTM C136		
Air content	ASTM C231	Job site	1 per 4 hours of placement work, plus one in the last hour of placement work
Penetration <sup>a</sup>	ASTM C360		
Slump <sup>a</sup>	ASTM C143		
Compressive strength	California Test 521		

<sup>a</sup>Test either penetration or slump

During placement of lean concrete base rapid setting, fabricate cylinders and test compressive strength for opening age and 7 days. Opening age tests must be performed in the presence of the Engineer.

**28-4.01D(3) Department Acceptance**

The Department accepts LCB rapid setting based on compliance with the requirement shown in the following table:

**LCB Rapid Setting Requirements for Acceptance**

Quality characteristic	Test method	Requirement
Compressive strength (min, psi at 7 days)	California Test 521 <sup>a</sup>	725

<sup>a</sup>Cylinders made under California Test 540

**Replace the 2nd and 3rd paragraphs in section 28-4.03A with:**

07-15-16

Concrete paving operations with equipment not supported by the base may start before opening age. Do not open pavement for traffic before opening age of the LCB rapid setting.

Any other paving operations must start after the final set time of the base. The base must have a compressive strength of at least 450 psi under California Test 521 before:

1. Placing HMA
2. Placing other base material
3. Operating equipment on the base

**Replace Reserved in section 28-5.01C with:**

07-15-16

Submit a concrete base QC plan.

**Replace the headings and paragraphs in section 28-5.01D(2) with:**

07-15-16

**28-5.01D(2) Quality Control**

**28-5.01D(2)(a) General**

Reserved

**28-5.01D(2)(b) Quality Control Manager**

Reserved

**28-5.01D(2)(c) Quality Control Testing**

Test the concrete base under the test methods and at the locations and frequencies shown in the following table:

**Concrete Base Sampling Location and Testing Frequencies**

Quality characteristic	Test method	Sample location	Minimum testing frequency <sup>a</sup>
Cleanness value	California Test 227	Source	1 per 500 cubic yards but at least 1 per shift
Sand equivalent	California Test 217		
Aggregate gradation	California Test 202		
Air content	California Test 504	Job site	1 per 500 cu yd but at least 1 per shift
Yield	California Test 518		1 per shift
Slump or penetration	ASTM C143 or California Test 533		1 per 2 hours of placement
Density	California Test 518		1 per shift
Aggregate moisture meter calibration <sup>b</sup>	California Test 223 or California Test 226		1 per shift
Modulus of rupture	California Test 524		1 per 500 cu yd but at least 1 per shift

<sup>a</sup>Test at the most frequent interval.

<sup>b</sup>Check calibration of the plant moisture meter by comparing moisture meter readings with California Test 223 or California Test 226 test results.

**28-5.01D(3) Department Acceptance**

The Department accepts a concrete base based on compliance with the requirements shown in the following table:

**Concrete Base Requirements for Acceptance**

Quality characteristic	Test method	Requirement
Modulus of rupture (min, psi at 28 days)	California Test 523	570

Acceptance for the modulus of rupture is on a lot basis. The Department provides the molds and machines for the modulus of rupture acceptance testing. Provide any material and labor the Engineer may require for the testing.

AA

**29 TREATED PERMEABLE BASES**

07-15-16

**Replace the headings and paragraphs in section 29-1.01 with:**

07-15-16

**29-1.01 GENERAL**

**29-1.01A Summary**

Section 29-1 includes general specifications for constructing treated permeable bases.

**29-1.01B Definitions**

Reserved

**29-1.01C Submittals**

Submit a treated permeable base quality control plan.

**29-1.01D Quality Assurance**

**29-1.01D(1) General**

Reserved

**29-1.01D(2) Quality Control****29-1.01D(2)(a) General**

Reserved

**29-1.01D(2)(b) Quality Control Plan**

Reserved

**29-1.01D(2)(c) Qualifications**

Reserved

**29-1.01D(3) Department Acceptance**

Reserved

**Replace the headings and paragraphs in section 29-2.01D with:**

07-15-16

**29-2.01D Quality Assurance****29-2.01D(1) General**

The Engineer determines the asphalt content of the asphalt mixture under California Test 382. The bitumen ratio, pounds of asphalt per 100 lb of dry aggregate, must not vary more than 0.5 lb of asphalt above or below the quantity designated by the Engineer. Samples used to determine the bitumen ratio are obtained from trucks at the plant or from the mat behind the paver before rolling. If the sample is taken from the mat behind the paver, the bitumen ratio must not be less than the quantity designated by the Engineer, less 0.7 lb of asphalt per 100 lb of dry aggregate.

**29-2.01D(2) Quality Control****29-2.01D(2)(a) General**

Reserved

**29-2.01D(2)(b) Quality Control Testing**

ATPB quality control must include testing the quality characteristics at the frequencies shown in the following table:

**QC Testing Frequencies**

Quality characteristic	Test method	Sampling location	Minimum frequency
Gradation	California Test 202	Stockpiles or plant	1 for every 4 hours of production but at least one per day of placement
Cleanness value	California Test 227	Stockpiles or plant	1 for every 4 hours of production but at least one per day
Percentage of crushed particles	California Test 205	Stockpiles or plant	1 test before production and one every 5,000 cu yd thereafter
Los Angeles rattler loss at 500 rev	California Test 211	Stockpiles or plant	1 test before production and one every 5,000 cu yd thereafter
Film stripping	California Test 302	Plant	1 test before production and one every 5000 cu yd thereafter
Asphalt content of the asphalt mixture	California Test 382	Plant, transportation units, windrows, or roadway	1 for every 4 hours of production but at least one per day

**29-2.01D(3) Department Acceptance**

The Department accepts ATPB based on aggregate gradation, cleanness value, percent of crushed particles, Los Angeles rattler, film stripping and asphalt content requirements specified in section 29-2.02 and section 29-2.01D(1).

The Engineer takes samples for aggregate gradation, cleanness value, percent of crushed particles, Los Angeles rattler, and film stripping from the plant.

The Engineer takes samples for asphalt content of the asphalt mixture from any of the following locations:

1. Plant
2. Truck
3. Windrow
4. Roadbed

**Replace the headings and paragraphs in section 29-3.01 with:**

07-15-16

**29-3.01 GENERAL**

**29-3.01A Summary**

Section 29-3 includes specifications for constructing cement treated permeable bases.

**29-3.01B Definitions**

Reserved

**29-3.01C Submittals**

Reserved

**29-3.01D Quality Assurance**

**29-3.01D(1) General**

Reserved

**29-3.01D(2) Quality Control**

**29-3.01D(2)(a) General**

Reserved

**29-3.01D(2)(b) Quality Control Testing**

CTPB quality control must include testing the quality characteristics at the frequencies shown in the following table:

**QC Testing Frequencies**

Quality characteristic	Test method	Sampling location	Minimum frequency
Gradation	California Test 202	Stockpiles or plant	1 for every 4 hours of production but at least one per day of placement
Cleanness value	California Test 227	Stockpiles or plant	1 for every 4 hours of production but at least one per day
Los Angeles rattler loss at 500 rev	California Test 211	Stockpiles or plant	1 test before production and one every 5,000 cu yd thereafter
Soundness	California Test 214	Stockpiles or plant	1 test before production and one every 5,000 cu yd thereafter

**29-3.01D(3) Department Acceptance**

The Department accepts CTPB based on aggregate gradation, cleanness value, Los Angeles rattler and soundness requirements in section 29-3.02.

The Engineer takes samples for aggregate gradation, cleanness value, Los Angeles rattler and soundness from the plant.

**Add to section 29-3.02A:**

Water must comply with section 90-1.02D.

07-15-16

**Replace 3rd in the 2nd paragraph in section 29-3.03 with:**

4th

07-15-16

^^

**30 RECLAIMED PAVEMENT**

07-15-16

**Replace section 30-1.01C(2)(c) in the 1st paragraph of section 30-3.01C(2)(c) with:**

section 30-1.01C(3)(c)

07-15-16



# DIVISION V SURFACINGS AND PAVEMENTS

## 37 BITUMINOUS SEALS

07-15-16

Replace section 37 with:

07-15-16

## 37 SEAL COATS

### 37-1 GENERAL

#### 37-1.01 GENERAL

##### 37-1.01A Summary

Section 37-1 includes general specifications for applying seal coats.

##### 37-1.01B Definitions

Reserved

##### 37-1.01C Submittals

At least 10 days before the preconstruction meeting submit a list of participants in the preconstruction meeting. Provide each participant's name, employer, title, and role in the production and placement of the seal coats.

At least 10 days before starting seal coat activities, submit the names of the authorized laboratories for quality control testing.

For each delivery of asphalt binder or asphaltic emulsion to the job site, submit a certificate of compliance and a copy of the specified test results.

For a seal coat that uses crumb rubber modifier, submit a Crumb Rubber Usage Report form monthly and at the end of project.

##### 37-1.01D Quality Assurance

###### 37-1.01D(1) General

For aggregate testing, quality control laboratories must be in compliance with the Department's Independent Assurance Program to be an authorized laboratory. Quality control personnel must be qualified under the Department's Independent Assurance Program.

For emulsion testing, quality control laboratories must participate in the AASHTO Material's Reference Laboratory proficiency sample program.

###### 37-1.01D(2) Preconstruction Meeting

Hold a preconstruction meeting within 5 days before start of seal coat work at a mutually agreed time and place with the Engineer and your:

1. Project superintendent
2. Project foreman
3. Traffic control foreman

Make arrangements for the conference facility. Preconstruction meeting participants must sign an attendance sheet provided by the Engineer. Be prepared to discuss:

1. Quality control testing
2. Acceptance testing
3. Seal coat placement
4. Proposed application rates for asphaltic emulsion or asphalt binder and aggregate.
5. Training on placement methods
6. Checklist of items for proper placement
7. Unique issues specific to the project, including:
  - 7.1. Weather
  - 7.2. Alignment and geometrics
  - 7.3. Traffic control requirements



- 7.4. Haul distances
- 7.5. Presence and absence of shaded areas
- 7.6. Any other local conditions
- 8. Contingency plan for material deliveries, equipment breakdowns, and traffic handling
- 9. Who in the field has authority to adjust application rates and how adjustments will be documented
- 10. Schedule of sweepings

### **37-1.02 MATERIALS**

Not Used

### **37-1.03 CONSTRUCTION**

#### **37-1.03A General**

If seal coat activities affect access to public parking, residential property, or commercial property, post signs at 100-foot intervals on the affected streets. Signs must display *No Parking – Tow Away*. Signs must state the dates and hours parking or access will be restricted. Notify residents, businesses, and local agencies at least 24 hours before starting activities. The notice must:

- 1. Describe the work to be performed
- 2. Detail streets and limits of activities
- 3. Indicate dates and work hours
- 4. Be authorized

Asphaltic emulsion or asphalt binder for seal coats may be reheated if necessary. After loading the asphaltic emulsion or asphalt binder into a truck for transport to the job site, do not heat asphaltic emulsion above 160 degrees F and asphalt rubber binder above 425 degrees F. During reheating, circulate or agitate the asphaltic emulsion or asphalt binder to prevent localized overheating.

Except for fog seals, apply quick setting Grade 1 asphaltic emulsions at a temperature from 75 to 130 degrees F and apply quick setting Grade 2 asphaltic emulsions at a temperature from 110 to 185 degrees F.

You determine the application rates for asphaltic emulsion or asphalt binder and aggregate and the Engineer authorizes the application rates.

#### **37-1.03B Equipment**

A self-propelled distributor truck for applying asphaltic emulsion or asphalt binder must be equipped with:

- 1. Pressure-type system with insulated tanks with circulating unit
- 2. Spray bars:
  - 2.1. With minimum length of 9 feet and full-circulating type
  - 2.2. With full-circulating-type extensions if needed to cover a greater width
  - 2.3. Adjustable to allow positioning at various heights above the surface to be treated
  - 2.4. Operated by levers such that 1 or all valves may be quickly opened or closed in one operation
- 3. Devices and charts to provide for accurate and rapid determination and control of asphaltic emulsion or asphalt binder quantities being applied. Include an auxiliary wheel type meter that registers:
  - 3.1. Speed in ft/min
  - 3.2. Trip by count
  - 3.3. Total distance in feet
- 4. Distribution system:
  - 4.1. Capable of producing a uniform application of asphaltic emulsion or asphalt binder in controlled quantities ranging from 0.02 to 1 gal/sq yd of surface and at a pressure ranging from 25 to 75 psi
  - 4.2. Pumps that spray asphaltic emulsion or asphalt binder within 0.02 gal/sq yd of the set rate
  - 4.3. With a hose and nozzle for application of asphaltic emulsion to areas inaccessible to the spray bar
  - 4.4. With pressure gauges and a thermometer for determining temperatures of the asphaltic emulsion or asphalt binder

You may use cab-controlled valves for the application of asphaltic emulsion or asphalt binder. The valves controlling the flow from nozzles must act positively to provide a uniform unbroken application of asphaltic emulsion or asphalt binder.

Maintain distributor and storage tanks at all times to prevent dripping.

**37-1.04 PAYMENT**

Not Used

**37-2 CHIP SEALS**

**37-2.01 GENERAL**

**37-2.01A General**

**37-2.01A(1) Summary**

Section 37-2.01 includes general specifications for applying chip seals.

**37-2.01A(2) Definitions**

Reserved

**37-2.01A(3) Submittals**

At least 15 days before starting placement of chip seal, submit:

1. Samples for:
  - 1.1. Asphaltic emulsion chip seal, two 1-quart wide mouth plastic containers with screw top lid of asphaltic emulsion
  - 1.2. Polymer modified asphaltic emulsion chip seal, two 1-quart wide mouth plastic containers with screw top lid of polymer modified asphaltic emulsion
  - 1.3. Asphalt rubber binder chip seal, two 1-quart cans of base asphalt binder
  - 1.4. Asphalt rubber binder chip seal, five 1-quart cans of asphalt rubber binder
2. Asphaltic emulsion, polymer modified asphaltic emulsion, asphalt binder or asphalt rubber binder data as follows:
  - 2.1. Supplier and Type/Grade of asphaltic emulsion or asphalt binder
  - 2.2. Type of modifier used including polymer or crumb rubber or both
  - 2.3. Percent of crumb rubber, if used as modifier
  - 2.4. Copy of the specified test results for asphaltic emulsion or asphalt binder
3. 50 lb of uncoated aggregate
4. Aggregate test results for the following:
  - 4.1. Gradation
  - 4.2. Los Angeles Rattler
  - 4.3. Percent of crushed particles
  - 4.4. Flat and elongated particles
  - 4.5. Film stripping
  - 4.6. Cleanness value
  - 4.7. Durability
5. Vialit test results

Submit quality control test results for the quality characteristics within the reporting times allowance after sampling shown in the following table:

**Quality Control Test Result Reporting**

Quality characteristic	Maximum reporting time allowance
Los Angeles Rattler loss (max, %)	48 hours
Percent of crushed particles (min, %)	48 hours
Flat and elongated particles (max by weight at 3:1, %)	48 hours
Film stripping (max, %)	48 hours
Durability (min)	48 hours
Gradation (percentage passing)	24 hours
Cleanness value (min)	24 hours
Asphaltic emulsion spread rate (gal/sq yd)	24 hours

Within 3 days after taking asphaltic emulsion or asphalt binder quality control samples, submit the authorized laboratory's test results.

**37-2.01A(4) Quality Assurance**

**37-2.01A(4)(a) General**

Reserved

**37-2.01A(4)(b) Quality Control**

**37-2.01A(4)(b)(i) General**

Reserved

**37-2.01A(4)(b)(ii) Aggregate**

All tests must be performed on uncoated aggregate except for film stripping which must be performed on precoated aggregate.

For aggregate, the authorized laboratory must perform sampling and testing at the specified frequency and location for the following quality characteristics:

**Aggregate Quality Control Requirements**

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Los Angeles Rattler loss (max, %) At 100 revolutions At 500 revolutions	California Test 211	1st day of production	See California Test 125
Percent of crushed particles Coarse aggregate (min, %) One-fractured face Two-fractured faces Fine aggregate (min, %) (Passing No. 4 sieve and retained on No. 8 sieve) One fractured face	AASHTO T 335	1st day of production	See California Test 125
Flat and elongated particles (max by weight at 3:1, %)	ASTM D4791	1st day of production	See California Test 125
Film stripping (max, %)	California Test 302	1st day of production	See California Test 125
Durability (min)	California Test 229	1st day of production	See California Test 125
Gradation (% passing)	California Test 202	2 per day	See California Test 125
Cleanness value (min)	California Test 227	2 per day	See California Test 125

**37-2.01A(4)(b)(iii) Chip Seals**

For a chip seal, the authorized laboratory must perform sampling and testing at the specified frequency and location for the following quality characteristics:

**Chip Seal Quality Control Requirements**

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Asphaltic emulsion binder spread rate (gal/sq yd)	California Test 339	1 per day per distributor truck	Pavement surface

**37-2.01A(4)(c) Department Acceptance**

Department Acceptance shall not apply to identified areas where the existing surfacing before application of chip seal, contains defective areas as determined by the Engineer and Contractor. At least 7 days

before starting placement of the chip seal, the Contractor shall submit a written list of existing defective areas, identifying the lane direction, lane number, starting and ending highway post mile locations, and defect type. The Engineer must agree on which of the identified areas are defective.

Defective areas are defined as one of the following:

1. Areas with wheel path rutting in excess of 3/8 inch when measured by placing a straightedge 12 feet long on the finished surface perpendicular to the center line and measuring the vertical distance between the finished surface and the lower edge of the straightedge
2. Areas exhibiting flushing

For a chip seal, acceptance is based on visual inspection for the following:

1. Uniform surface texture
2. Raveling, which consists of the separation of the aggregate from the asphaltic emulsion or asphalt binder
3. Flushing, which consists of the occurrence of a film of asphaltic material on the surface of the chip seal.
4. Streaking, which consists of alternating longitudinal bands of asphaltic emulsion or asphalt binder without uniform aggregate retention, approximately parallel with the lane line.

Areas of raveling, flushing or streaking that are greater than 0.5 sq ft shall be considered defective and must be repaired.

Raveling and streaking must be repaired by placing an additional layer of chip seal over the defective area.

For asphaltic emulsion or asphalt binder, acceptance is based on the Department's sampling and testing for compliance with the requirements for the quality characteristics specified.

For aggregate, acceptance is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

**Chip Seal Aggregate Acceptance Criteria**

Quality characteristic	Test method	Requirements
Los Angeles Rattler loss (max, %)		
At 100 revolutions	California Test 211	10
At 500 revolutions		40
Percent of crushed particles:	AASHTO T 335	
Coarse aggregate (min, %)		
One-fractured face		95
Two-fractured faces		90
Fine aggregate (min, %)		
(Passing No. 4 sieve and retained on No. 8 sieve)		
One fractured face		70
Flat and elongated particles (max by weight at 3:1, %)	ASTM D4791	10
Film stripping (max, %)	California Test 302	25
Durability (min)	California Test 229	52
Gradation (% passing by weight)	California Test 202	Aggregate Gradation table shown under Materials for the chip seal type specified.
Cleanness value (min)	California Test 227	80

If test results for the aggregate gradation do not comply with specifications, you may remove the chip seal represented by these tests or request that it remain in place with a payment deduction. The deduction is \$1.75 per ton for the aggregate represented by the test results.

If test results for aggregate cleanness value do not comply with the specifications, you may remove the chip seal represented by these tests or you may request that the chip seal remain in place with a pay deduction corresponding to the cleanness value shown in the following table:

**Chip Seal Cleanness Value Deductions**

Cleanness value	Deduction
80 or over	None
79	\$2.00 /ton
77-78	\$4.00 /ton
75-76	\$6.00 /ton

If the aggregate cleanness value is less than 75, remove the chip seal.

**37-2.01B Materials**

**37-2.01B(1) General**

Reserved

**37-2.01B(2) Asphaltic Emulsions and Asphalt Binders**

Reserved

**37-2.01B(3) Aggregate**

**37-2.01B(3)(a) General**

Aggregate must be broken stone, crushed gravel, or both.

Aggregate must comply with the requirements shown in the following table:

**Chip Seal Aggregate Requirements**

Quality characteristic	Test method	Requirements
Los Angeles Rattler loss (max, %)		
At 100 revolutions	California Test 211	10
At 500 revolutions		40
Percent of crushed particles	AASHTO T 335	
Coarse aggregate (min, %)		
One-fractured face		95
Two-fractured faces		90
Fine aggregate (min, %)		
(Passing No. 4 sieve and retained on No. 8 sieve)		
One fractured face		70
Flat and elongated particles (max by weight at 3:1, %)	ASTM D4791	10
Film stripping (max, %)	California Test 302	25
Durability (min)	California Test 229	52
Gradation (% passing by weight)	California Test 202	Aggregate Gradation table shown under Materials for the chip seal type specified.
Cleanness value (min)	California Test 227	80

The authorized laboratory must conduct the Vialit test using the proposed asphaltic emulsion or asphalt binder and aggregate for compliance with the requirements shown in the following table:

### Chip Retention Requirements

Quality characteristic	Test method	Requirement
Chip retention (%)	Vialit test method for aggregate in chip seals, French chip (Modified) <sup>a</sup>	95

<sup>a</sup>The asphaltic emulsion or asphalt binder must be within the field placement temperature range and application rate during specimen preparation. For asphalt binder cure the specimen for first 2 hours at 100 °F.

#### **37-2.01B(3)(b) Precoated Aggregate**

Precoating of aggregate must be performed at a central mixing plant. The plant must be authorized under the Department's *MPQP*.

When precoating aggregate, do not recombine fine materials collected in dust control systems.

Precoated aggregate must be preheated from 260 to 325 degrees F. Coat with any of the asphalts specified in the table titled "Performance Graded Asphalt Binder" in section 92. The asphalt must be from 0.5 to 1.0 percent by weight of dry aggregate. You determine the exact asphalt rate for precoating of aggregate.

Do not stockpile precoated aggregate.

#### **37-2.01C Construction**

##### **37-2.01C(1) General**

For chip seals on 2-lane, 2-way roadways, place a W8-7 (LOOSE GRAVEL) sign and a W13-1 (35) plaque at 2,000-foot maximum intervals along each side of the traveled way where aggregate is spread on a traffic lane and at public roads or streets entering the chip seal area. Place the 1st W8-7 sign in each direction where traffic first encounters the loose aggregate, regardless of which lane the aggregate is spread on. A W13-1 (35) plaque is not required where the posted speed limit is less than 40 mph.

For chip seals on freeways, expressways, and multilane conventional highways, place a W8-7, (LOOSE GRAVEL) sign and a W13-1 (35) plaque at 2,000-foot maximum intervals along the outside edge of the traveled way nearest to the lane worked on, at on ramps, and at public roads or streets entering the chip seal area. Place the 1st W8-7 sign where the aggregate starts with respect to the direction of travel on that lane. A W13-1 (35) plaque is not required where the posted speed limit is less than 40 mph.

Pilot cars must have cellular or radio contact with other pilot cars and personnel in the work zone. The maximum speed of the pilot cars conveying or controlling traffic through the traffic control zone must be 15 mph on 2-lane, two-way highways and 25 mph on multilane divided and undivided highways. Pilot cars must only use traffic lanes open to traffic.

On the days that closures are not allowed, you may use a moving closure to maintain the seal coat surface. The moving closure is only allowed during daylight hours when traffic will be the least inconvenienced and delayed. The Engineer determines the hours for the moving closure.

Maintain signs in place at each location until the final sweeping of the chip seal surface for that location is complete. Signs may be set on temporary portable supports with the W13-1 sign below the W8-7 sign or on barricades with the W13-1 sign alternating with the W8-7 sign.

Schedule chip seal activities so that the chip seals are placed on both lanes of the traveled way each work shift.

If traffic is routed over a surface where a chip seal application is intended, the chip seal must not be applied to more than half the width of the traveled way at a time, and the remaining width must be kept free of obstructions and open to traffic until the previously applied width is ready for traffic use.

Wherever maintenance sweeping of the chip seal surface is complete, place permanent traffic stripes and pavement markings within 10 days.

If you fail to place the permanent traffic stripes and pavement markings within the specified time, the Department withholds 50 percent of the estimated value of the chip seal work completed that has not received permanent traffic stripes and pavement markings.

### **37-2.01C(2) Equipment**

Equipment for chip seals must include and comply with the following:

1. Aggregate haul trucks must have:
  - 1.1. Tailgate that discharge aggregate
  - 1.2. Device to lock onto the rear aggregate spreader hitch
  - 1.3. Dump bed that will not push down on the spreader when fully raised
  - 1.4. Dump bed that will not spill aggregate on the roadway when transferred to the spreader hopper
  - 1.5. Tarpaulin to cover precoated aggregate when haul distance exceeds 30 minutes or ambient temperature is less than 65 degrees F
2. Self-propelled aggregate spreaders must have:
  - 2.1. Aggregate hopper in the rear
  - 2.2. Belt conveyor that carries the aggregate to the front
  - 2.3. Spreading hopper capable of providing a uniform aggregate spread rate over the entire width of the traffic lane in 1 application.
3. Self-propelled power brooms must:
  - 3.1. Not be steel-tined brooms on emulsion chip seals
  - 3.2. Be capable of removing loose aggregate adjacent to barriers that prevent aggregate from being swept off the roadway, including curbs, gutters, dikes, berms, and railings
4. Pneumatic or foam filled rubber tired rollers must:
  - 4.1. Be an oscillating type at least 4 feet wide
  - 4.2. Be self-propelled and reversible
  - 4.3. Have tires of equal size, diameter, type, and ply
  - 4.4. Carry at least 3,000 lbs of load on each wheel
  - 4.5. Have tires with an air pressure of  $100 \pm 5$  psi or be foam filled

### **37-2.01C(3) Surface Preparation**

Before applying chip seals, cover manholes, valve and monument covers, grates, or other exposed facilities located within the area of application, using a plastic or oil resistant construction paper secured by tape or adhesive to the facility being covered. Reference the covered facilities with enough control points to relocate the facilities after the application of the chip seal.

Immediately before applying chip seals, clean the surface to receive a chip seal by removing any extraneous material affecting adhesion of the chip seal with the existing surface and drying. Use self-propelled power brooms to clean the existing pavement.

### **37-2.01C(4) Placement**

#### **37-2.01C(4)(a) General**

Schedule the operations so that chip seals are placed on both lanes of the traveled way each work shift. At the end of the work shift, the end of the chip seals on both lanes must generally match.

#### **37-2.01C(4)(b) Applying Asphaltic Emulsions or Asphalt Binders**

Prevent spraying on existing pavement not intended for chip seals or on previously applied chip seals using a material such as building paper. Remove the material after use.

Align longitudinal joints between chip seal applications with designated traffic lanes.

For asphaltic emulsion or asphalt binder, overlap longitudinal joints by not more than 4 inches. You may overlap longitudinal joints up to 8 inches if authorized.

For areas not accessible to a truck distributor bar apply:

1. Asphaltic emulsions by hand spraying
2. Asphalt binders with a squeegee or other authorized means

You may overlap the asphaltic emulsion or asphalt binder applications before the application of aggregate at longitudinal joints.

Do not apply the asphaltic emulsion or asphalt binder unless there is sufficient aggregate at the job site to cover the asphaltic emulsion or asphalt binder.

Discontinue application of asphaltic emulsion or asphalt binder early enough to comply with lane closure requirements. Apply to 1 lane at a time and cover the lane width entirely in 1 operation.

### **37-2.01C(4)(c) Spreading Aggregates**

#### **37-2.01C(4)(c)(i) General**

Prevent vehicles from driving on asphaltic emulsion or asphalt binder before spreading aggregate.

Spread aggregate within 10 percent of your determined rate.

Spread aggregate at a uniform rate over the full lane width in 1 application. Apply to 1 lane at a time.

Sweep excess aggregate at joints before spreading adjacent aggregate.

Operate the spreader at speeds slow enough to prevent aggregate from rolling over after dropping.

If the spreader is not moving, aggregate must not drop. If you stop spreading and aggregate drops, remove the excess aggregate before resuming activities.

#### **37-2.01C(4)(c)(ii) Precoated Aggregate Application**

During transit, cover precoated aggregate with tarpaulins if the ambient air temperature is below 65 degrees F or the haul time exceeds 30 minutes.

When applied, precoated aggregate must be from 225 to 325 degrees F.

### **37-2.01C(4)(d) Finishing**

#### **37-2.01C(4)(d)(i) General**

Remove piles, ridges, or unevenly distributed aggregate. Repair permanent ridges, bumps, streaks or depressions in the finished surface. Spread additional aggregate and roll if aggregate is picked up by rollers or vehicles.

Chip seal joints between adjacent applications of a chip seal must be smooth, straight, uniform, and completely covered.

A coverage is 1 roller movement over the entire width of lane. A pass is 1 roller movement parallel to the chip seal application in either direction. Overlapping passes are part of the coverage being made and are not part of a subsequent coverage. Do not start a new coverage until completing the previous coverage.

Before opening to traffic, finish the chip seals in the following sequence:

1. Perform initial rolling consisting of 1 coverage with a pneumatic-tired roller
2. Perform final rolling consisting of 2 coverages with a pneumatic-tired roller
3. Sweep excess aggregate from the roadway and adjacent abutting areas
4. Apply a flush coat if specified
5. Remove covers from the facilities

#### **37-2.01C(4)(d)(ii) Traffic Control With Pilot Car**

For 2-lane 2-way roadways under 1-way traffic control, upon completion of final rolling, traffic must be controlled with pilot cars and routed over the new chip seal for a period of 2 to 4 hours before opening the lane to traffic not controlled with pilot cars.

For multilane roadways, when traffic is controlled with pilot cars, a maximum of 1 lane in the direction of travel must be open to traffic. Traffic must be controlled with pilot cars and be routed on the new chip seal surface of the lane for a minimum of 2 hours after completion of the initial sweeping and before opening the lane to traffic not controlled with pilot cars. Once traffic controlled with pilot cars is routed over the chip seal at a particular location, continuous control must be maintained at that location until the chip seal placement and sweeping on adjacent lanes to receive a chip seal is completed.



### **37-2.01C(4)(d)(iii) Sweeping**

Sweeping must be performed after the chip seal has set and there is no damage or dislodging of aggregate from the chip seal surface. As a minimum, sweeping is required at the following times:

1. On 2-lane 2-way roadways, from 2 to 4 hours after traffic, controlled with pilot cars, has been routed on the chip seal
2. On multilane roadways, from 2 to 4 hours after aggregate have been placed
3. In addition to previous sweeping, perform final sweeping immediately before opening any lane to public traffic, not controlled with pilot cars

### **37-2.01C(4)(d)(iv) Excess Aggregate**

Dispose of excess aggregate. If ordered, salvaging and stockpiling of excess aggregate is change order work.

### **37-2.01C(4)(e) Chip Seal Maintenance**

Perform sweeping on the morning following the application of aggregate on any lane that has been open to traffic not controlled with pilot cars and before starting any other activities.

Chip seal surfaces must be maintained for 4 consecutive days from the day aggregate is applied. Maintenance must include sweeping to maintain a surface free of loose aggregate and to prevent formation of corrugations. Sweeping must not dislodge aggregate set in asphaltic emulsion or asphalt binder.

After 4 consecutive days, excess aggregate must be removed from the paved areas.

### **37-2.01D Payment**

If there is no bid item for traffic control system, furnishing and using a pilot car is included in the various items of the work involved in applying the chip seal.

The payment quantity for precoated aggregate is the weight measured after the aggregate is preheated and precoated with asphalt binder.

If recorded batch weights are printed automatically, the payment quantity for aggregate is the weight determined from the printed batch weights if:

1. Total weight for the precoated aggregate per batch is printed
2. Total asphalt binder weight per batch is printed
3. Zero tolerance weight is printed before weighing the first batch and after weighing the last batch for each truckload
4. Time, date, mix number, load number, and truck identification are correlated with a load slip
5. Copy of the recorded batch weights is certified by a licensed weighmaster

## **37-2.02 ASPHALTIC EMULSION CHIP SEALS**

### **37-2.02A General**

#### **37-2.02A(1) Summary**

Section 37-2.02 includes specifications for applying asphaltic emulsion chip seals. An asphaltic emulsion chip seal includes applying an asphaltic emulsion, followed by aggregate, and then a flush coat.

A double asphaltic emulsion chip seal is the application of an asphaltic emulsion followed by aggregate, applied twice in sequence and then a flush coat.

#### **37-2.02A(2) Definitions**

Reserved

#### **37-2.02A(3) Submittals**

Immediately after sampling, submit two 1-quart plastic containers of asphaltic emulsion taken in the presence of the Engineer. Samples must be submitted in insulated shipping container.

**37-2.02A(4) Quality Assurance****37-2.02A(4)(a) General**

Reserved

**37-2.02A(4)(b) Quality Control****37-2.02A(4)(b)(i) General**

Reserved

**37-2.02A(4)(b)(ii) Asphaltic Emulsions**

Circulate asphaltic emulsion in the distributor truck before sampling. Take samples from the distributor truck at mid load or from a sampling tap or thief. Before taking samples, draw and dispose of 1 gallon. In the presence of the Engineer, take two 1-quart samples in a plastic container with lined sealed lid for acceptance testing.

For asphaltic emulsion, the authorized laboratory must perform quality control sampling and testing at the specified frequency and location for the following quality characteristics:

**Asphaltic Emulsion**

Quality characteristic	Test method	Minimum sampling and testing frequency	Sampling location
Saybolt Furol Viscosity, at 25 °C (Saybolt Furol seconds)	AASHTO T 59	Minimum 1 per day per delivery truck	Distributor truck
Sieve Test (%)			
Storage stability, 1 day (%)			
Residue by distillation (%)			
Particle charge <sup>a</sup>			
Tests on Residue from Distillation Test:			
Penetration, 25 °C	AASHTO T 49	Minimum 1 per day per delivery truck	Distributor truck
Ductility	AASHTO T 51		
Solubility in trichloroethylene	AASHTO T 44		

<sup>a</sup>If the result of the particle charge is inconclusive, the asphaltic emulsion must be tested for pH under ASTM E70. Grade QS1h asphaltic emulsion must have a minimum pH of 7.3. Grade CQS1h asphaltic emulsion must have a maximum pH of 6.7.

**37-2.02A(4)(c) Department Acceptance**

Aggregate acceptance is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

**Aggregate Gradation Acceptance Criteria**

Quality characteristic	Test method	Requirement		
Gradation (% passing by weight)	California Test 202	3/8"	5/16"	1/4"
Sieve size:		--	--	--
3/4"		100	--	--
1/2"		85-100	100	100
3/8"		0-15	0-50	60-85
No. 4		0-5	0-15	0-25
No. 8		--	0-5	0-5
No. 16		--	0-3	0-3
No. 30		0-2	0-2	0-2
No. 200				

**37-2.02B Materials****37-2.02B(1) General**

Reserved

### 37-2.02B(2) Asphaltic Emulsions

Reserved

### 37-2.02B(3) Aggregate

Aggregate gradation for an asphaltic emulsion chip seal must comply with the requirements shown in the following table:

Quality characteristic	Test method	Requirement		
Gradation (% passing by weight)	California Test 202	3/8"	5/16"	1/4"
Sieve size:		--	--	--
3/4"		100	--	--
1/2"		85–100	100	100
3/8"		0–15	0–50	60–85
No. 4		0–5	0–15	0–25
No. 8		--	0–5	0–5
No. 16		--	0–3	0–3
No. 30		0–2	0–2	0–2
No. 200				

### 37-2.02C Construction

#### 37-2.02C(1) General

Reserved

#### 37-2.02C(2) Asphaltic Emulsions

Asphaltic emulsions must be applied within the application rate ranges shown in the following table:

Aggregate gradation	Application rate range (gal/sq yd)
3/8"	0.30–0.45
5/16"	0.25–0.35
1/4"	0.20–0.30

For double asphaltic emulsion chip seals, the asphaltic emulsions must be applied within the application rates shown in the following table:

Double chip seals	Application rate range (gal/sq yd)
1st application	0.30–0.45
2nd application	0.20–0.30

When applied, the temperature of the asphaltic emulsions must be from 130 to 180 degrees F.

Apply asphaltic emulsions when the ambient air temperature is from 65 to 110 degrees F and the pavement surface temperature is at least 80 degrees F.

Do not apply asphaltic emulsions when weather forecasts predict the ambient air temperature will fall below 39 degrees F within 24 hours after application.

#### 37-2.02C(3) Spreading Aggregates

Aggregate must be spread within the spread rate ranges shown in the following table:

### Aggregate Spread Rates

Aggregate gradation	Spread rate range (lb/sq yd)
3/8"	20–30
5/16"	16–25
1/4"	12–20

For double asphaltic emulsion chip seals, aggregate must be spread within the spread rate ranges shown in the following table:

### Aggregate Spread Rates

Double chip seal	Spread rate range (lb/sq yd)
1st application	23–30
2nd application	12–20

Remove excess aggregate on the 1st application before the 2nd application of asphaltic emulsion.

You may stockpile aggregate for asphaltic emulsion chip seals if you prevent contamination. Aggregate must have a damp surface at spreading. If water visibly separates from the aggregate, do not spread. You may re-dampen aggregate in the delivery vehicle.

Spread aggregate before an asphaltic emulsion sets or breaks.

Do not spread aggregate more than 2,500 feet ahead of the completed initial rolling.

#### **37-2.02D Payment**

Not Used

### **37-2.03 POLYMER MODIFIED ASPHALTIC EMULSION CHIP SEALS**

#### **37-2.03A General**

##### **37-2.03A(1) Summary**

Section 37-2.03 includes specifications for applying polymer modified asphaltic emulsion chip seals. A polymer modified asphaltic emulsion chip seal includes applying a polymer modified asphaltic emulsion, followed by aggregate, and then a flush coat.

A double polymer modified asphaltic emulsion chip seal is the application of a polymer modified asphaltic emulsion followed by aggregate, applied twice in sequence and then a flush coat.

##### **37-2.03A(2) Definitions**

Reserved

##### **37-2.03A(3) Submittals**

Immediately after sampling, submit two 1-quart cans of polymer modified asphaltic emulsion taken in the presence of the Engineer. A sample must be submitted in an insulated shipping container.

##### **37-2.03A(4) Quality Assurance**

###### **37-2.03A(4)(a) General**

Reserved

###### **37-2.03A(4)(b) Quality Control**

###### **37-2.03A(4)(b)(i) General**

Reserved

###### **37-2.03A(4)(b)(ii) Polymer Modified Asphaltic Emulsions**

Circulate polymer modified asphaltic emulsions in the distributor truck before sampling. Take samples from the distributor truck at mid load or from a sampling tap or thief. Before taking samples, draw and dispose of 1 gallon. In the presence of the Engineer, take two 1-quart samples for acceptance testing.

For polymer modified asphaltic emulsions, the authorized laboratory must perform quality control sampling and testing at the specified frequency and location for the following quality characteristics:

**Polymer Modified Asphaltic Emulsion**

Quality characteristic	Test method	Minimum sampling and testing frequency	Sampling location
Saybolt Furol Viscosity, at 50 °C (Saybolt Furol seconds)	AASHTO T 59	Minimum 1 per day per delivery truck	Distributor truck
Settlement, 5 days (max, %)			
Storage stability test, 1 day (max, %)			
Sieve test (max, %)			
Demulsibility (min, %)			
Particle charge			
Ash content (max, %)			
Residue by evaporation (min, %)	California Test 331		
Tests on residue from evaporation test:			
Penetration, 25 °C	AASHTO T 49	Minimum 1 per day per delivery truck	Distributor truck
Penetration, 4 °C, 200g for 60 seconds	AASHTO T 49		
Ductility, 25 °C (min, mm)	AASHTO T 51		
Torsional recovery (min, %)	California Test 332		
Ring and Ball Softening Point (min, °F)	AASHTO T 53		

**37-2.03A(4)(c) Department Acceptance**

Aggregate acceptance is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

**Aggregate Gradation Acceptance Criteria**

Quality characteristic	Test method	Requirement		
		3/8"	5/16"	1/4"
Gradation (% passing by weight)	California Test 202	3/8"	5/16"	1/4"
Sieve size:				
3/4"		--	--	--
1/2"		100	--	--
3/8"		85–100	100	100
No. 4		0–15	0–50	60–85
No. 8		0–5	0–15	0–25
No. 16		--	0–5	0–5
No. 30		--	0–3	0–3
No. 200		0–2	0–2	0–2

**37-2.03B Materials**

**37-2.03B(1) General**

Reserved

**37-2.03B(2) Polymer Modified Asphaltic Emulsions**

A polymer modified asphaltic emulsion must include elastomeric polymer.

A polymer modified asphaltic emulsion must be Grade PMRS2, PMRS2h, PMCRS2, or PMCRS2h. Polymer content in percent by weight does not apply.

A polymer modified asphaltic emulsion must comply with section 94 and the quality characteristic requirements in the following table:

### Polymeric Asphaltic Emulsion

Quality characteristic	Test method	Requirement
Penetration, 4 °C, 200g for 60 seconds (min)	AASHTO T 49	6
Ring and Ball Softening Point (min, °F)	AASHTO T 53	135

#### 37-2.03B(3) Aggregate

The aggregate gradation for a polymer modified asphaltic emulsion chip seal must comply with the requirements shown in the following table:

#### Asphaltic Emulsion Chip Seal Aggregate Gradation

Quality characteristic	Test method	Requirement		
Gradation (% passing by weight) Sieve Size	California Test 202	3/8"	5/16"	1/4"
3/4"		--	--	--
1/2"		100	--	--
3/8"		85–100	100	100
No. 4		0–15	0–50	60–85
No. 8		0–5	0–15	0–25
No. 16		--	0–5	0–5
No. 30		--	0–3	0–3
No. 200		0–2	0–2	0–2

#### 37-2.03C Construction

Polymer modified asphaltic emulsions must be applied within the application rate ranges shown in the following table:

#### Polymer Modified Asphaltic Emulsion Application Rates

Aggregate gradation	Application rate range (gal/sq yd)
3/8"	0.30–0.45
5/16"	0.25–0.35
1/4"	0.20–0.30

For double polymer modified asphaltic emulsion chip seals, polymer modified asphaltic emulsions must be applied within the application rates shown in the following table:

#### Polymer Modified Asphaltic Emulsion Application Rates

Double application	Application rate range (gal/sq yd)
1st application	0.30–0.45
2nd application	0.20–0.30

Apply polymer modified asphaltic emulsions when the ambient air temperature is from 60 to 105 degrees F and the pavement surface temperature is at least 80 degrees F.

Do not apply polymer modified asphaltic emulsions when weather forecasts predict the ambient air temperature will fall below 39 degrees F within 24 hours after application.

Aggregate must be spread within the spread rate ranges shown in the following table:

### Aggregate Spread Rates

Chip seal type	Spread rate range (lb/sq yd)
3/8"	20–30
5/16"	16–25
1/4"	12–20

For double chip seals, aggregate must be spread within spread rate ranges shown in the following table:

### Aggregate Spread Rates

Double application	Spread rate range (lb/sq yd)
1st application	23–30
2nd application	12–20

Remove excess aggregate on the 1st application before the 2nd application of asphaltic emulsion.

You may stockpile aggregate for the polymer modified asphaltic emulsion chip seals if you prevent contamination. Aggregate must have damp surfaces at spreading. If water visibly separates from the aggregate, do not spread. You may redampen aggregate in the delivery vehicle.

Spread aggregate before the polymer modified asphaltic emulsion sets or breaks.

Do not spread aggregate more than 2,500 feet ahead of the completed initial rolling.

#### 37-2.03D Payment

Not Used

#### 37-2.04 ASPHALT RUBBER BINDER CHIP SEALS

##### 37-2.04A General

##### 37-2.04A(1) Summary

Section 37-2.04 includes specifications for applying asphalt rubber binder chip seals.

An asphalt rubber binder chip seal consists of applying asphalt rubber binder followed by heated aggregate precoated with asphalt binder followed by a flush coat.

##### 37-2.04A(2) Definitions

**crumb rubber modifier:** Combination of ground or granulated high natural scrap tire crumb rubber and scrap tire crumb rubber derived from waste tires described in Pub Res Code § 42703.

**descending viscosity reading:** Subsequent viscosity reading at least 5 percent lower than the previous viscosity reading.

**high natural scrap tire crumb rubber:** Material containing 40 to 48 percent natural rubber.

**scrap tire crumb rubber:** Any combination of vehicle tires or tire buffing.

##### 37-2.04A(3) Submittals

At least 5 business days before use, submit the permit issued by the local air district for asphalt rubber binder field blending equipment and application equipment. If an air quality permit is not required by the local air district for producing asphalt rubber binder, submit verification from the local air district that an air quality permit is not required.

For each delivery of asphalt rubber binder ingredients to the job site, submit a certificate of compliance with a copy of the specified test results.

Submit a certified volume or weight slip for each delivery of asphalt rubber binder ingredients and asphalt rubber binder.

Submit a SDS for each asphalt rubber binder ingredient and the asphalt rubber binder.

At least 15 days before use, submit:

1. Samples of each asphalt rubber binder ingredient:
  - 1.1. 2 lbs of scrap tire crumb rubber
  - 1.2. 2 lbs of high natural scrap tire crumb rubber
  - 1.3. Two 1-quart cans of base asphalt binder
  - 1.4. Two 1-quart cans of asphalt modifier
2. Asphalt rubber binder formulation and data as follows:
  - 2.1. For asphalt modifier, include:
    - 2.1.1. Source of asphalt modifier
    - 2.1.2. Type of asphalt modifier
    - 2.1.3. Percentage of asphalt modifier by weight of asphalt binder
    - 2.1.4. Percentage of combined asphalt binder and asphalt modifier by weight of asphalt rubber binder
    - 2.1.5. Test results for the specified quality characteristics
  - 2.2. For crumb rubber modifier, include:
    - 2.2.1. Each source and type of scrap tire crumb rubber and high natural scrap tire crumb rubber
    - 2.2.2. Percentage of scrap tire crumb rubber and high natural scrap tire crumb rubber by total weight of asphalt rubber binder
    - 2.2.3. Test results for the specified quality characteristics
  - 2.3. For asphalt rubber binder, include minimum reaction time and temperature

Immediately after sampling, submit five 1-quart cans of asphalt rubber binder taken in the presence of the Engineer. Sample must be submitted in insulated shipping containers.

Submit notification 15 minutes before each viscosity test or submit a schedule of testing times.

Submit the log of asphalt rubber binder descending viscosity test results within 1 business day after sampling.

Submit asphalt rubber binder quality control viscosity test results within 1 business day after sampling.

**37-2.04A(4) Quality Assurance**

**37-2.04A(4)(a) General**

The equipment used in producing asphalt rubber binder and the equipment used in spreading asphalt rubber binder must be permitted for use or exempted by the local air district.

**37-2.04A(4)(b) Quality Control**

**37-2.04A(4)(b)(i) General**

Reserved

**37-2.04A(4)(b)(ii) Asphalt Modifiers**

For asphalt modifiers, the authorized laboratory must perform quality control sampling and testing at the specified frequency for the following quality characteristics:

<b>Asphalt Modifier for Asphalt Rubber Binder</b>		
Quality characteristic	Test method	Frequency
Viscosity	ASTM D445	1 per shipment
Flash point	ASTM D92	
Molecular Analysis:		
Asphaltenes	ASTM D2007	1 per shipment
Aromatics	ASTM D2007	

**37-2.04A(4)(b)(iii) Crumb Rubber Modifiers**

Sample and test scrap tire crumb rubber and high natural scrap tire crumb rubber separately.

Perform quality control sampling and testing at the specified frequency for the following quality characteristics:



**Crumb Rubber Modifier**

Quality characteristic	Test method	Frequency
Scrap tire crumb rubber gradation	California Test 385	1 per 10,000
High natural scrap tire crumb rubber gradation	California Test 385	1 per 3,400 lb
Wire in CRM	California Test 385	1 per 10,000 lb
Fabric in CRM	California Test 385	
CRM particle length	--	
CRM specific gravity	California Test 208	
Natural rubber content in high natural scrap tire crumb rubber	ASTM D297	1 per 3,400 lb

**37-2.04A(4)(b)(iv) Asphalt Rubber Binders**

For asphalt rubber binders, the authorized laboratory must perform quality control sampling and testing at the specified frequency and location for the following quality characteristics:

**Asphalt Rubber Binder Quality Control Requirements**

Quality characteristic	Test method	Sampling location	Frequency
Descending viscosity <sup>a</sup> at 375 °F (Pa•s x 10 <sup>-3</sup> )	ASTM D7741	Reaction vessel	1 per lot <sup>b</sup>
Viscosity at 375 °F (Pa•s x 10 <sup>-3</sup> )	ASTM D7741	Distribution truck	15 minutes before use per lot <sup>b</sup>
Cone penetration at 25 °C (0.10 mm)	ASTM D217	Distribution truck	1 per lot <sup>b</sup>
Resilience at 25 °C (% rebound)	ASTM D5329		
Softening point (°C)	ASTM D36		

<sup>a</sup>Start taking viscosity readings at least 45 minutes after adding crumb rubber modifier and continue taking viscosity readings every 30 minutes until 2 consecutive descending viscosity readings have been obtained and the final viscosity complies with the specification requirement.

<sup>b</sup>A lot is defined in the *MPQP*.

Retain samples from each lot. Test samples for cone penetration, resilience, and softening point for the first 3 lots and if all 3 lots pass, the testing frequency may be reduced to once for every 3 lots.

If QC test results indicate that the asphalt rubber binder does not comply with the specifications, take corrective action and notify the Engineer.

**37-2.04A(4)(c) Department Acceptance**

**37-2.04A(4)(c)(i) General**

Reserved

**37-2.04A(4)(c)(ii) Asphalt Modifiers**

The Department accepts asphalt modifier based on compliance with the requirements shown in the following table:

**Asphalt Modifier for Asphalt Rubber Binder**

Quality characteristic	Test method	Requirement
Viscosity at 100 °C (m <sup>2</sup> /s x 10 <sup>-6</sup> )	ASTM D445	X ± 3 <sup>a</sup>
Flash point (min, °C)	ASTM D92	207
Molecular Analysis:		
Asphaltenes (max, % by mass)	ASTM D2007	0.1
Aromatics (min, % by mass)	ASTM D2007	55

<sup>a</sup>The symbol "X" is the asphalt modifier viscosity.

**37-2.04A(4)(c)(iii) Crumb Rubber Modifiers**

Scrap tire CRM and high natural CRM are sampled and tested separately.

The Department accepts scrap tire CRM and high natural CRM based on compliance with the requirements shown in the following table:

**Crumb Rubber Modifier for Asphalt Rubber Binder**

Quality characteristic	Test method	Requirement
Wire in CRM (max, %)	California Test 385	0.01
Fabric in CRM (max, %)	California Test 385	0.05
CRM particle length (max, in)	--	3/16
CRM specific gravity	California Test 208	1.1–1.2
Natural rubber content in high natural CRM (%)	ASTM D297	40.0–48.0

The Department accepts CRM gradation based on the requirements shown in the following table:

**Crumb Rubber Modifier Gradation Requirements**

Quality characteristic	Test method	Requirement			
		Scrap tire crumb rubber		High natural scrap tire crumb rubber	
Gradation (% passing by weight) Sieve size:	California Test 385	Operating range	Contract compliance	Operating range	Contract compliance
No. 8		100	100	--	--
No. 10		95–100	90–100	100	100
No. 16		35–85	32–88	92–100	85–100
No. 30		2–25	1–30	25–95	20–98
No. 50		0–10	0–15	6–35	2–40
No. 100		0–5	0–10	0–7	0–10
No. 200		0–2	0–5	0–3	0–5

If a test result for CRM gradation does not comply with the specifications, the Department deducts the corresponding amount for each gradation test as shown in the following table:

Material	Gradation test result <sup>a</sup>	Deduction
Scrap tire crumb rubber	Operating range < TR < Contract compliance	\$250
Scrap tire crumb rubber	TR > Contract compliance	\$1,100
High natural scrap tire crumb rubber	Operating range < TR < Contract compliance	\$250
High natural scrap tire crumb rubber	TR > Contract compliance	\$600

<sup>a</sup>Test Result = TR

Each gradation test for scrap tire crumb rubber represents 10,000 lb or the quantity used in that day's production, whichever is less.

Each gradation test for high natural scrap tire crumb rubber represents 3,400 lb or the quantity used in that day's production, whichever is less.

**37-2.04A(4)(c)(iv) Asphalt Rubber Binders**

For Department acceptance testing, take a sample of asphalt rubber binder in the Engineer's presence every 5 lots or once a day, whichever is greater. Each sample must be in five 1-quart cans with an open top and friction lid.

For an asphalt rubber binder, acceptance is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

### Asphalt Rubber Binder

Quality characteristic	Test method	Requirement
Cone penetration at 25 °C (0.10 mm)	ASTM D217	25–60
Resilience at 25 °C (% rebound)	ASTM D5329	18–50
Softening point (°C)	ASTM D36	55–88
Viscosity at 375 °F (Pa•s x 10 <sup>-3</sup> ) <sup>a</sup>	ASTM D7741	1,500–2,500

<sup>a</sup>Prepare sample for viscosity test under California Test 388.

#### 37-2.04A(4)(c)(v) Precoated Aggregate

The Department accepts precoated aggregate based on compliance with the requirements shown in the following table:

#### Precoated Aggregate Gradation Acceptance Criteria

Quality Characteristic	Test method	Requirement
1/2" gradation (% passing by weight)	California Test 202	
Sieve size:		
3/4"		100
1/2"		85–90
3/8"		0–30
No. 4		0–5
No. 8		--
No. 200	0–1	
3/8" gradation (% passing by weight)	California Test 202	
Sieve size:		
3/4"		100
1/2"		95–100
3/8"		70–85
No. 4		0–15
No. 8		0–5
No. 200	0–1	

#### 37-2.04B Materials

##### 37-2.04B(1) General

Reserved

##### 37-2.04B(2) Asphalt Binders

Asphalt binder used as the base binder for asphalt rubber binder must comply with the specifications for asphalt binder. Do not modify asphalt binder with polymer.

##### 37-2.04B(3) Asphalt Modifiers

An asphalt modifier must be a resinous, high flash point, and aromatic hydrocarbon. An asphalt modifier must comply with the requirements shown in the following table:

#### Asphalt Modifier for Asphalt Rubber Binder

Quality characteristic	Test method	Requirement
Viscosity at 100 °C (m <sup>2</sup> /s x 10 <sup>-6</sup> )	ASTM D445	X ± 3 <sup>a</sup>
Flash point (min, CL.O.C., °C)	ASTM D92	207
Molecular analysis:		
Asphaltenes by mass (max, %)	ASTM D2007	0.1
Aromatics by mass (min, %)	ASTM D2007	55

<sup>a</sup>X denotes the proposed asphalt modifier viscosity from 19 to 36. A change in X requires a new asphalt rubber binder submittal.

##### 37-2.04B(4) Crumb Rubber Modifiers

The CRM to be used must be on the Authorized Materials List for crumb rubber modifier.

The CRM must be ground or granulated at ambient temperature.

Scrap tire crumb rubber and high natural scrap tire crumb rubber must be delivered to the asphalt rubber binder production site in separate bags.

Steel and fiber must be separated. If steel and fiber are cryogenically separated, it must occur before grinding and granulating. Cryogenically-produced CRM particles must be large enough to be ground or granulated.

The CRM must be dry, free-flowing particles that do not stick together. A maximum of 3 percent calcium carbonate or talc by weight of CRM may be added. The CRM must not cause foaming when combined with the asphalt binder and asphalt modifier.

The CRM must comply with the requirements shown in the following table:

**Crumb Rubber Modifier for Asphalt Rubber Binder**

Quality characteristic	Test method	Requirement
Wire in CRM (max, %)	California Test 385	0.01
Fabric in CRM (max, %)	California Test 385	0.05
CRM particle length (max, in)	--	3/16
CRM specific gravity	California Test 208	1.1–1.2

The CRM must comply with the requirements shown in the following table:

**Crumb Rubber Modifier Requirements**

Quality characteristic	Test method	Requirement	
		Scrap tire crumb rubber	High natural scrap tire crumb rubber
Acetone extract (%)	ASTM D297	6.0–16.0	4.0–16.0
Rubber hydrocarbon (min, %)		42.0–65.0	50.0
Natural rubber content (%)		22.0–39.0	40.0–48.0
Carbon black content (%)		28.0–38.0	--
Ash content (max, %)		8.0	--

Scrap tire crumb rubber gradation must comply with the gradation requirements shown in the following table:

**Scrap Tire Crumb Rubber Gradation**

Quality characteristic	Test method	Requirement		
		Gradation limit	Operating range	Contract compliance
Gradation (% passing by weight)	California Test 385			
Sieve size:				
No. 8		100	100	100
No. 10		98–100	95–100	90–100
No. 16		45–75	35–85	32–88
No. 30		2–20	2–25	1–30
No. 50		0–6	0–10	0–15
No. 100		0–2	0–5	0–10
No. 200	0	0–2	0–5	

High natural scrap tire crumb rubber gradation must comply with the gradation requirements shown in the following table:

### High Natural Scrap Tire Crumb Rubber Gradation

Quality characteristic	Test method	Requirement		
		Gradation limit	Operating range	Contract compliance
Gradation (% passing by weight) Sieve size:	California Test 385			
No. 10		100	100	100
No. 16		95–100	92–100	85–100
No. 30		35–85	25–95	20–98
No. 50		10–30	6–35	2–40
No. 100		0–4	0–7	0–10
No. 200		0–1	0–3	0–5

#### 37-2.04B(5) Asphalt Rubber Binders

An asphalt rubber binder must be a combination of:

1. Asphalt binder
2. Asphalt modifier
3. Crumb rubber modifier

Asphalt rubber binder blending equipment must be authorized under the Department's *MPQP*.

The blending equipment must allow the determination of weight percentages of each asphalt rubber binder ingredient.

An asphalt rubber binder must be  $79 \pm 1$  percent by weight asphalt binder and  $21 \pm 1$  percent by weight of CRM. The minimum percentage of CRM must be 20.0 percent and lower values must not be rounded up.

The CRM must be  $75 \pm 2$  percent by weight scrap tire crumb rubber and  $25 \pm 2$  percent by weight high natural scrap tire crumb rubber.

An asphalt modifier and asphalt binder must be blended at the production site. An asphalt modifier must be from 2.5 to 6.0 percent by weight of the asphalt binder in the asphalt rubber binder. The asphalt rubber binder supplier determines the exact percentage.

If blended before adding CRM, the asphalt binder must be from 375 to 440 degrees F when an asphalt modifier is added and the mixture must circulate for at least 20 minutes. An asphalt binder, asphalt modifier, and CRM may be proportioned and combined simultaneously.

The blend of an asphalt binder and an asphalt modifier must be combined with the CRM at the asphalt rubber binder production site. The asphalt binder and asphalt modifier blend must be from 375 to 440 degrees F when the CRM is added. Combined ingredients must be allowed to react at least 45 minutes at temperatures from 375 to 425 degrees F except the temperature must be at least 10 degrees F below the flash point of the asphalt rubber binder.

After reacting, the asphalt rubber binder must comply with the requirements shown in the following table:

#### Asphalt Rubber Binder

Quality characteristic	Test method	Requirement
Cone penetration at 25 °C (0.10 mm)	ASTM D217	25–60
Resilience at 25 °C (% rebound)	ASTM D5329	18–50
Softening point (°C)	ASTM D36	55–88
Viscosity at 375 °F ( $\text{Pa}\cdot\text{s} \times 10^{-3}$ ) <sup>a</sup>	ASTM D7741	1,500–2,500

<sup>a</sup>Prepare sample for viscosity test under California Test 388.

Maintain asphalt rubber binder at a temperature from 375 to 415 degrees F.

Stop heating unused asphalt rubber binder 4 hours after the 45-minute reaction period. Reheating asphalt rubber binder that cools below 375 degrees F is a reheat cycle. Do not exceed 2 reheat cycles. If reheating, the asphalt rubber binder must be from 375 to 415 degrees F before use.

During reheating, you may add CRM. The CRM must not exceed 10 percent by weight of the asphalt rubber binder. Allow added CRM to react for at least 45 minutes. Reheated asphalt rubber binder must comply with the specifications for asphalt rubber binder.

**37-2.04B(6) Precoated Aggregate**

Before precoating with asphalt binder, aggregate for an asphalt rubber binder chip seal must comply with the gradation requirements shown in the following table:

**Asphalt Rubber Binder Chip Seal Aggregate Gradation**

Quality characteristic	Test method	Requirement	
Gradation (% passing by weight)	California Test 202	1/2"	3/8"
Sieve size:			
3/4"		100	100
1/2"		85–90	95–100
3/8"		0–30	70–85
No. 4		0–5	0–15
No. 8		--	0–5
No. 200		0–1	0–1

**37-2.04C Construction**

**37-2.04C(1) General**

Reserved

**37-2.04C(2) Equipment**

Distributor trucks must be equipped with:

1. Mixing and heating unit
2. Observation platform on the rear of the truck for an observer on the platform to see the nozzles and unplug them if needed

**37-2.04C(3) Asphalt Rubber Binder Application**

Apply the asphalt rubber binder when the ambient temperature is from 60 to 105 degrees F and the pavement surface temperature is at least 55 degrees F.

Do not apply the asphalt rubber binder unless enough aggregate is available at the job site to cover the asphalt rubber binder within 2 minutes. Intersections, turn lanes, gore points, and irregular areas must be covered within 15 minutes.

Do not apply asphalt rubber binder when pavement is damp or during high wind conditions. If authorized, you may adjust the distributor bar height and distribution speed and use shielding equipment during high wind conditions.

When applied, the temperature of the asphalt rubber binder must be from 385 to 415 degrees F.

Apply the asphalt rubber binder at a rate from 0.55 to 0.65 gal/sq yd. You may reduce the application rate by 0.050 gal/sq yd in the wheel paths.

**37-2.04C(4) Precoated Aggregate Spreading**

Spread aggregate at a rate from 28 to 40 lb/sq yd. Do not spread aggregate more than 200 feet ahead of the completed initial rolling.

**37-2.04C(5) Rolling and Sweeping**

Perform initial rolling within 90 seconds of spreading aggregate. If authorized for final rolling, you may use a steel-wheeled roller weighing from 8 to 10 tons in static mode only.

Perform a final sweeping before Contract acceptance. The final sweeping must not dislodge aggregate.

#### **37-2.04D Payment**

Asphalt rubber binder is measured as specified for asphalt binder.

### **37-2.05 STRESS ABSORBING MEMBRANE INTERLAYERS**

#### **37-2.05A General**

Section 37-2.05 includes specifications for placing stress absorbing membrane interlayers (SAMI).

Comply with section 37-2.04 except a flush coat is not required.

Traffic must not be allowed on a SAMI.

#### **37-2.05B Materials**

For a SAMI, aggregate must comply with the 3/8-inch gradation.

#### **37-2.05C Construction**

If a SAMI is overlaid in the same work shift, section 37-2.01C(4)(e) does not apply.

Final sweeping is not required for a SAMI.

#### **37-2.05D Payment**

Not Used

### **37-2.06 MODIFIED ASPHALT BINDER CHIP SEALS**

Reserved

### **37-2.07 SCRUB SEALS**

Reserved

## **37-3 SLURRY SEALS AND MICRO-SURFACINGS**

### **37-3.01 GENERAL**

#### **37-3.01A General**

##### **37-3.01A(1) Summary**

Section 37-3.01 includes general specifications for applying slurry seals and micro-surfacings.

##### **37-3.01A(2) Definitions**

Reserved

##### **37-3.01A(3) Submittals**

At least 15 days before starting placement of a slurry seal or micro-surfacing, submit:

1. Samples for:
  - 1.1. Asphaltic emulsion slurry seal, two 1-quart wide mouth plastic containers with screw top lid of asphaltic emulsion
  - 1.2. Polymer modified asphaltic emulsion slurry seal, two 1-quart wide mouth plastic containers with screw top lid of polymer modified asphaltic emulsion
  - 1.3. Micro-surfacing, two 1-quart wide mouth plastic containers with screw top lid of micro-surfacing emulsion
2. Asphaltic emulsion, polymer modified asphaltic emulsion, or micro-surfacing emulsion data as follows:
  - 2.1. Supplier and Type/Grade of asphaltic emulsion
  - 2.2. Type of modifier polymer for polymer modified asphaltic emulsion or micro-surfacing emulsion
  - 2.3. Copy of the specified test results for asphaltic emulsion, polymer modified asphaltic emulsion, or micro-surfacing emulsion
3. 50 lb of aggregate
4. Aggregate test results for the followings:
  - 4.1. Gradation
  - 4.2. Los Angeles Rattler
  - 4.3. Percent of crushed particles

- 4.4 Sand equivalent
- 4.5 Durability

At least 10 days before starting placement of a slurry seal or micro-surfacing, submit a laboratory report of test results and the proposed mix design from an authorized laboratory. The authorized laboratory must sign the laboratory report and mix design.

The report must include:

1. Test results used in the mix design compared with specification requirements
2. Proportions based on the dry weight of aggregate, including ranges, for:
  - 2.1. Aggregate
  - 2.2. Water
  - 2.3. Additives
  - 2.4. Mineral filler
  - 2.5. Slurry seal emulsion or micro-surfacing emulsion residual asphalt content
3. Recommended changes to the proportions based on heating the mixture to 100 degrees F and mixing for 60 seconds, if atmospheric temperatures during application will be 90 degrees F or above, for:
  - 3.1. Water
  - 3.2. Additives
  - 3.3. Mineral filler
4. Quantitative moisture effects on the aggregate's unit weight determined under ASTM C29M

If the mix design consists of the same materials covered by a previous laboratory report, you may submit the previous laboratory report that must include material testing data performed within the previous 12 months for authorization.

If you change any of the materials in the mix design, submit a new mix design and laboratory report at least 10 days before starting slurry seal or micro-surfacing work.

Submit a certificate of compliance as specified for asphaltic emulsion in section 94-1.01C with each shipment of asphaltic emulsion, polymer modified asphaltic emulsion or micro-surfacing emulsion.

Submit quality control test results for the quality characteristics within the reporting times allowance after sampling shown in the following table:

**Quality Control Test Reporting Requirements**

Quality characteristic	Maximum reporting time allowance
Los Angeles Rattler loss (max, %)	2 business days
Percent of crushed particles (min, %)	2 business days
Durability (min)	2 business days
Resistance of fine aggregate to degradation by abrasion in the Micro-Deval Apparatus (% loss by weight)	2 business days
Gradation (% passing by weight)	48 hours
Sand equivalent (min)	48 hours
Moisture content (%)	48 hours

Within 3 days after taking asphaltic emulsion, polymer modified asphaltic emulsion or micro-surfacing emulsion quality control samples, submit the authorized laboratory's test results.

**37-3.01A(4) Quality Assurance**

**37-3.01A(4)(a) General**

Your authorized laboratory must be able to perform International Slurry Surfacing Association tests and mix design.



**37-3.01A(4)(b) Quality Control****37-3.01A(4)(b)(i) General**

Reserved

**37-3.01A(4)(b)(ii) Aggregate**

For aggregate, the authorized laboratory must perform sampling and testing at the specified frequency and location for the following quality characteristics:

**Aggregate Quality Control**

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Los Angeles Rattler loss (max, %) At 500 revolutions	California Test 211	1st day of production	See California Test 125
Percent of crushed particles (min, %)	AASHTO T 335	1st day of production	See California Test 125
Sand equivalent (min)	California Test 217	1 per working stockpile per day	See California Test 125
Resistance of fine aggregate to degradation by abrasion in the Micro-Deval Apparatus (% loss by weight)	ASTM D7428	1 per working stockpile per day	See California Test 125
Gradation (% passing by weight)	California Test 202	1 per working stockpile per day	See California Test 125
Moisture content, from field stockpile (%)	AASHTO T 255 <sup>a</sup>	1 per working stockpile per day	See California Test 125

<sup>a</sup>Test aggregate moisture at field stockpile every 2 hours if you are unable to maintain the moisture content to within a maximum daily variation of  $\pm 0.5$  percent.

**37-3.01A(4)(b)(iii) Slurry Seals and Micro-surfacings**

Reserved

**37-3.01A(4)(c) Department Acceptance**

Slurry Seal and micro-surfacing acceptance is based on:

1. Visual inspection for the following:
  - 1.1. Uniform surface texture throughout the work limits.
  - 1.2. Marks in the surface:
    - 1.2.1. Up to 4 marks in the completed slurry seal or micro-surfacing surface that are up to 1 inch wide and up to 6 inches long per 1000 square feet of slurry seal or micro-surfacing placed.
    - 1.2.2. No marks in the completed slurry seal or micro-surfacing surface that are over 1 inch wide or 6 inches long.
  - 1.3. Excessive raveling consisting of the separation of the aggregate from the asphaltic emulsion, polymer modified asphaltic emulsion or micro-surfacing emulsion.
  - 1.4. Bleeding consists of the occurrence of a film of asphaltic material on the surface of the slurry seal or micro-surfacing.
  - 1.5. Delaminating of slurry seal or micro-surfacing from the existing pavement.
  - 1.6. Rutting or wash-boarding.
2. Department's sampling and testing for compliance with the requirements for aggregate shown in the following table:

### Aggregate Gradation Acceptance Criteria

Quality characteristic	Test method	Requirements		
Gradation (% passing by weight) Sieve Size:	California Test 202	Type I	Type II	Type III
3/8"		--	100	100
No. 4		100	94-100	70-90
No. 8		90-100	65-90	45-70
No. 16		60-90	40-70	28-50
No. 30		40-65	25-50	19-34
No. 200		10-20	5-15	5-15

An aggregate gradation test represents 300 tons or 1 day's production, whichever is less.

If test results for aggregate gradation do not comply with the specifications, you may remove the slurry seal or micro-surfacing represented by the test results or request it remain in place with a payment deduction. If your request is authorized, the Department deducts:

1. \$1.75 per ton of slurry seal for each noncompliant aggregate gradation
2. \$2.00 per ton of micro-surfacing for each noncompliant aggregate gradation

#### 37-3.01B Materials

##### 37-3.01B(1) General

Additional water must not cause separation of the asphaltic emulsion, polymer modified asphaltic emulsion or micro-surfacing emulsion from the aggregate before placement.

You may use an additive that does not adversely affect the slurry seal or micro-surfacing.

##### 37-3.01B(2) Aggregate

Aggregate must be rock dust. Aggregate must be free from vegetable matter, deleterious substances, caked or clay lumps, and oversized particles.

Aggregate for a slurry seal and micro-surfacing must comply with the gradations shown in the following table:

#### Aggregate Gradation

Quality characteristic	Test method	Requirements		
Gradation (% passing by weight) Sieve size:	California Test 202	Type I	Type II	Type III
3/8"		--	100	100
No. 4		100	94-100	70-90
No. 8		90-100	65-90	45-70
No. 16		60-90	40-70	28-50
No. 30		40-65	25-50	19-34
No. 200		10-20	5-15	5-15

#### 37-3.01C Construction

##### 37-3.01C(1) General

Before applying slurry seals or micro-surfacings, cover manholes, valve and monument covers, grates, and other exposed facilities located within the area of application using plastic or oil resistant construction paper secured by tape or adhesive to the facility being covered. Reference the covered facilities with enough control points to relocate the facilities after application of the slurry seals or micro-surfacings.

##### 37-3.01C(2) Proportioning

Proportion slurry seal and micro-surfacing ingredients in compliance with the authorized mix design.

### **37-3.01C(3) Mixing and Spreading Equipment**

#### **37-3.01C(3)(a) General**

Mixing and spreading equipment for slurry seals and micro-surfacings must proportion the asphaltic emulsions, water, aggregate, and any additives by volume and mix them in continuous pug mill mixers.

Introduce emulsions into the mixer with a positive displacement pump. If you use a variable-rate pump, the adjusting unit must be sealed in its calibrated position.

Introduce water into the mixer through a meter that measures gallons.

Choose a truck mounted mixer-spreader or continuous self-loading mixer spreader.

#### **37-3.01C(3)(b) Truck Mounted Mixer Spreaders**

Truck mounted mixer spreaders must comply with:

1. Rotating and reciprocating equipment must be covered with metal guards.
2. Proportion aggregate using a belt feeder with an adjustable cutoff gate. The Engineer verifies the height of the gate opening.
3. Belt feeder must have a depth monitor device. The depth monitor device must automatically shut down power to the belt feeder when the aggregate depth is less than 70 percent of the target depth.
4. Separate monitor device must detect the revolutions of the belt feeder. This device must automatically shut down power to the belt feeder if it detects no revolutions. If the belt feeder is an integral part of the equipment's drive chain, the monitor device is not required.
5. Aggregate belt feeder must be connected directly to the drive on the emulsion pump. The aggregate feeder drive shaft must have a revolution counter reading the nearest 0.10 revolution for micro-surfacing, and nearest 1 revolution for slurry seal.
6. Emulsion storage must be equipped with a device that automatically shuts down power to the emulsion pump and aggregate belt feeder when the level of stored emulsion is lowered. To allow for normal fluctuations, there may be a delay of 3 seconds between detection of low emulsion storage levels or low aggregate depths and automatic power shut down.
7. Emulsion storage must be located immediately before the emulsion pump.
8. Emulsion storage tank must have a temperature indicator at the pump suction level. The indicator must be accurate to  $\pm 5$  degrees F.
9. No-flow and revolution warning devices must be in working condition. Low-flow indicators must be visible while walking alongside the equipment.

#### **37-3.01C(3)(c) Continuous Self-Loading Mixer Spreaders**

Continuous self-loading mixer spreaders must be automatically sequenced and self-propelled. The mixing machine must deliver each material to a double shafted mixer and discharge the mixed material on a continuous flow basis. The mixing machines must have sufficient storage capacity to maintain a continuous supply of material to the proportioning controls. The mixing machine operators must have full control of forward and reverse speeds during placement.

#### **37-3.01C(3)(d) Spreader Boxes**

The spreader boxes used to spread slurry seals and micro-surfacings must be:

1. Capable of spreading the slurry seal or micro-surfacing a minimum of 12 feet wide and preventing the loss of slurry seal or micro-surfacing.
2. Equipped with flexible rubber belting on each side. The belting must contact the pavement to prevent the loss of slurry seal or micro-surfacing from the box.
3. Equipped to uniformly apply the slurry seal or micro-surfacing on superelevated sections and shoulder slopes. Micro-surfacing spreader box must be equipped with reversible motor driven augers.
4. Equipped with a series of strike-off devices at its rear.
  - 4.1. The leading strike off device must be:
    - 4.1.1. Fabricated of a suitable material such as steel or stiff rubber
    - 4.1.2. Designed to maintain close contact with the pavement during spreading
    - 4.1.3. Capable of obtaining the specified thickness
    - 4.1.4. Capable of being adjusted to the various pavement cross sections
  - 4.2. The final strike-off device must be:
    - 4.2.1. Fabricated of flexible material that produces a uniform texture in the finished surface

4.2.2. Cleaned daily and changed if longitudinal scouring occurs in the slurry seal or micro-surfacing

5. Clean and free of slurry seal or micro-surfacing at the start of each work shift.

#### **37-3.01C(3)(e) Shoulder Equipment**

Spread the slurry seal or micro-surfacing on shoulders with a device such as an edge box that forms clean and straight joints and edges.

#### **37-3.01C(3)(f) Equipment Calibration**

Equipment calibration must comply with the *MPQP*. Notify the Engineer at least 5 business days before calibrating.

If the Department authorizes a truck or continuous mixer spreader, its calibration is valid for 6 months provided you:

1. Use the same truck or continuous mixer spreader verified with a unique identifying number
2. Use the same materials in compliance with the authorized mix design
3. Do not perform any repair or alteration to the proportioning systems

Calibrate the adjustable cut-off gate settings of each truck or continuous mixer spreader on the project to achieve the correct delivery rate of aggregate and emulsion per revolution of the aggregate feeder under the *MPQP*.

Checks must be performed for each aggregate source using an authorized vehicle scale.

Individual checks of the aggregate belt feeder's delivery rate to the pug mill mixer must not vary more than 2 percent from the average of 3 runs of at least 3 tons each.

Before using a variable-rate emulsion pump, the pump must be calibrated and sealed in the calibrated condition under the *MPQP*.

Individual checks of the emulsion pump's delivery rate to the pug mill mixer must not vary more than 2 percent from the average of 3 runs of at least 500 gal each.

#### **37-3.01C(4) Surface Preparation**

Immediately before applying slurry seals or micro-surfacings, clean the surface to receive slurry seals or micro-surfacings by removing any extraneous material affecting adhesion of the slurry seal or micro-surfacing with the existing surface. Use self-propelled power brooms or other methods such as flushing to clean the existing pavement.

#### **37-3.01C(5) Placement**

##### **37-3.01C(5)(a) General**

If truck-mounted mixer-spreaders are used, keep at least 2 operational spreaders at the job site during placement.

Spread slurry seals and micro-surfacings uniformly and do not spot, rehandle, or shift the mixture. However in areas inaccessible to spreading equipment, spread the slurry seal or micro-surfacing mixtures with hand tools or other authorized methods. If placing with hand tools, lightly dampen the area first.

You may fog the roadway surface with water ahead of the spreader box. The fog spray must be adjusted for pavement:

1. Temperature
2. Surface texture
3. Dryness

You determine the application rates for slurry seals or micro-surfacings and the Engineer authorizes the application rates. Spread within 10 percent of authorized rate.

The mixtures must be uniform and homogeneous after spreading, and there must not be separation of the emulsion and aggregate after setting.

### **37-3.01C(5)(b) Weather Conditions**

Only place slurry seals or micro-surfacings if both the pavement and air temperatures are at least 50 degrees F and rising. The expected high temperature must be at least 65 degrees F within 24 hours after placement.

Do not place slurry seals or micro-surfacings if rain is imminent or the air temperature is expected to be below 36 degrees F within 24 hours after placement.

### **37-3.01C(5)(c) Joints**

Transverse and longitudinal joints must be:

1. Uniform
2. Straight
3. Neat in appearance
4. Without material buildup
5. Without uncovered areas

Transverse joints must be butt-type joints.

Prevent double placement at transverse joints over previously placed slurry seals or micro-surfacings.

Place longitudinal joints:

1. On centerlines, lane lines, edge lines, or shoulder lines
2. With overlaps not more than 4 inches

You may request other longitudinal joint patterns if they do not adversely affect the slurry seals or micro-surfacings.

The maximum difference between the pavement surface and the bottom edge of a 12-foot straightedge placed perpendicular to the longitudinal joint must be 0.04 foot.

### **37-3.01C(5)(d) Finished Surfaces**

Finished slurry seals or micro-surfacings must be smooth and free of irregularities such as scratch or tear marks. You may leave up to 4 marks that are up to 1 inch wide and 6 inches long per 75 linear feet of slurry seal or micro-surfacing placed. Do not leave any marks that are over 1 inch wide or 6 inches long.

### **37-3.01C(5)(e) Maintenance Sweeping**

Sweep the slurry seals or micro-surfacings 24 hours after placement without damaging the slurry seals or micro-surfacings. For 4 days afterwards, sweep the slurry seals or micro-surfacings daily unless determined otherwise by the Engineer.

### **37-3.01C(5)(f) Repair of Early Distress**

The slurry seals or micro-surfacings must not show bleeding, raveling, separation, or other distresses for 15 days after placing. If bleeding, raveling, delaminating, rutting, or wash-boarding occurs after placing the slurry seals or micro-surfacings, make repairs using an authorized method.

### **37-3.01D Payment**

Not Used

## **37-3.02 SLURRY SEALS**

### **37-3.02A General**

#### **37-3.02A(1) Summary**

Section 37-3.02 includes specifications for applying slurry seals.

Applying a slurry seal consists of spreading a mixture of asphaltic emulsion or polymer modified asphaltic emulsion, aggregate, additives, and water on a surface or pavement.

#### **37-3.02A(2) Definitions**

Reserved

**37-3.02A(3) Submittals**

Immediately after sampling, submit two 1-quart wide mouth plastic containers of asphaltic emulsion or polymer modified asphaltic emulsion taken in the presence of the Engineer. Samples must be submitted in insulated shipping containers.

**37-3.02A(4) Quality Assurance****37-3.02A(4)(a) General**

Reserved

**37-3.02A(4)(b) Quality Control****37-3.02A(4)(b)(i) General**

Take samples of asphaltic emulsion and polymer modified asphaltic emulsion from the tank truck at mid load or from a sampling tap or thief. Before taking samples, draw and dispose of 1 gallon. In the presence of the Engineer take two 1-quart samples in wide mouth plastic containers with lined, sealed lids for acceptance testing.

**37-3.02A(4)(b)(ii) Asphaltic Emulsion**

For asphaltic emulsions, the authorized laboratory must perform quality control sampling and testing at the specified frequency and location for the following quality characteristics:

**Asphaltic Emulsion**

Quality characteristic	Test method	Minimum sampling and testing frequency	Sampling location
Saybolt Furol Viscosity, at 25 °C (Saybolt Furol seconds)	AASHTO T 59	Minimum 1 per day per delivery truck	Delivery truck
Sieve Test (%)			
Storage stability, 1 day (%)			
Residue by distillation (%)			
Particle charge <sup>a</sup>			
Tests on Residue from Distillation Test:			
Penetration, 25 °C	AASHTO T 49	Minimum 1 per day per delivery truck	Delivery truck
Ductility	AASHTO T 51		
Solubility in trichloroethylene	AASHTO T 44		

<sup>a</sup>If the result of the particle charge is inconclusive, the asphaltic emulsion must be tested for pH under ASTM E70. Grade QS1h asphaltic emulsion must have a minimum pH of 7.3. Grade CQS1h asphaltic emulsion must have a maximum pH of 6.7.

**37-3.02A(4)(b)(iii) Polymer Modified Asphaltic Emulsion**

For polymer modified asphaltic emulsions, the authorized laboratory must perform quality control sampling and testing at the specified frequency and location for the following quality characteristics:

**Polymer Modified Asphaltic Emulsion**

Quality characteristic	Test method	Minimum sampling and testing frequency	Sampling Location
<b>Tests on emulsion:</b>			
Saybolt Furol Viscosity at 25 °C (Saybolt Furol seconds)	AASHTO T 59	Minimum 1 per day per delivery truck	Delivery truck
Sieve test (%)	AASHTO T 59		
Storage stability after 1 day (%)	AASHTO T 59		
Residue by evaporation (min, %)	California Test 331		
Particle charge	AASHTO T 59		
<b>Tests on residue by evaporation:</b>			
Penetration at 25 °C	AASHTO T 49	Minimum 1 per day per delivery truck	Delivery truck
Ductility at 25 °C (min, mm)	AASHTO T 51		
Torsional recovery (min, %)	California Test 332		
Or  Polymer content based on residual asphalt (min, %)	California Test 401		

**37-3.02A(4)(c) Department Acceptance**

For a slurry seal asphaltic emulsion and polymer modified asphaltic emulsion, acceptance is based on the Department's sampling and testing for compliance with the requirements for the quality characteristics specified.

Aggregate acceptance is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

**Aggregate Acceptance Criteria**

Quality characteristic	Test method	Requirement
Los Angeles Rattler loss (max, %) At 500 revolutions	California Test 211 <sup>a</sup>	35
Percent of crushed particles (min, %)	California Test 205	95
Durability (min)	California Test 229	55
Sand equivalent (min)	California Test 217	45
Type I		
Type II		
Type III		60

<sup>a</sup>California Test 211 must be performed on the source aggregate before crushing.

A sand equivalent test represents 300 tons or 1 day's production, whichever is less.

If test results for sand equivalent do not comply with the specifications, you may remove the slurry seal represented by the test results or request it remain in place with a payment deduction. If your request is authorized, the Department deducts \$1.75 per ton of slurry seal for each noncompliant sand equivalent test.

**37-3.02B Materials**

**37-3.02B(1) General**

Reserved

**37-3.02B(2) Asphaltic Emulsions**

An asphaltic emulsion must comply with the requirements in Section 94. The asphaltic emulsion must be Grade CQS1h.

**37-3.02B(3) Polymer Modified Asphaltic Emulsions**

A polymer modified asphaltic emulsion must:

1. Consist of an elastomeric polymer mixed with an asphaltic material uniformly emulsified with water and an emulsifying or stabilization agent.
2. Use either neoprene polymer or butadiene and styrene copolymer. The polymer must be homogeneous and milled into the asphaltic emulsion at the colloid mill.
3. Be Grade PMCQS1h and must comply with the requirements shown in the following table:

**Polymer Modified Asphaltic Emulsion Requirements**

Quality characteristic	Test method	Requirement
<b>Tests on emulsion:</b>		
Saybolt Furol Viscosity at 25 °C (Saybolt Furol seconds)	AASHTO T 59	15–90
Sieve test (%)	AASHTO T 59	0–0.3
Storage stability after 1 day (%)	AASHTO T 59	0–1
Residue by evaporation (min, %)	California Test 331	60
Particle charge	AASHTO T 59	Positive
<b>Tests on residue by evaporation:</b>		
Penetration at 25 °C	AASHTO T 49	40–90
Ductility at 25 °C (min, mm)	AASHTO T 51	400
Torsional recovery (min, %)	California Test 332	18
Or		
Polymer content based on residual asphalt (min, %)	California Test 401	2.5

**37-3.02B(4) Aggregate**

Aggregate must comply with the quality characteristic requirements shown in the following table:

**Aggregate Requirements**

Quality characteristic	Test method	Requirement
Los Angeles Rattler loss (max, %) At 500 revolutions	California Test 211 <sup>a</sup>	35
Percent of crushed particles (min, %)	California Test 205	95
Durability (min)	California Test 229	55
Sand equivalent (min)		
Type I	California Test 217	45
Type II		55
Type III		60

<sup>a</sup>California Test 211 must be performed on the source aggregate before crushing. The aggregate supplier must certify that the crushed aggregate being used on the project is manufactured from the source aggregate complying with the LA rattler requirements.

**37-3.02B(5) Slurry Seal Mix Design**

The slurry seal mix design, using project source aggregate, an asphaltic emulsion, and set-control agents if any, must comply with the requirements shown in the following table:



### Slurry Seal Mix Design Requirements

Quality characteristic	Test method <sup>a</sup>	Requirement
Consistency (max, mm)	Technical Bulletin 106	30
Wet stripping	Technical Bulletin 114	Pass
Compatibility	Technical Bulletin 115	Pass <sup>b</sup>
Cohesion test, within 1 hour (min, kg-mm)	Technical Bulletin 139	200
Wet track abrasion (max, g/m <sup>2</sup> )	Technical Bulletin 100	810

<sup>a</sup>Test methods are by the International Slurry Surfacing Association.

<sup>b</sup>Mixing test must pass at the maximum expected air temperature at the job site during placement.

The mix design must have the percent of asphaltic residue, based on percentage by weight of the dry aggregate, within the ranges shown in the following table:

Slurry seal type	Residue range
Type I	10–16
Type II	7.5–13.5
Type III	6.5–12.0

Determine the exact percentage based on the design asphalt binder content and the asphalt residual content of the asphaltic emulsion furnished.

#### **37-3.02C Construction**

##### **37-3.02C(1) General**

Reserved

##### **37-3.02C(2) Proportioning**

After proportioning, slurry seal mixtures must be workable.

##### **37-3.02C(3) Mixing and Spreading Equipment**

Reserved

##### **37-3.02C(4) Placement**

The slurry seal spread rates must be within the ranges shown in the following table:

<b>Slurry Seal Spread Rates</b>	
Slurry seal type	Application range (lb of dry aggregate/sq yd)
Type I	8–12
Type II	10–18
Type III	20–25

Within 4 hours after placement, slurry seals must be set enough to allow traffic without pilot cars. Protect slurry seals from damage until it has set and will not adhere or be picked up by vehicle tires. Slurry seals must not exhibit distress from traffic such as bleeding, raveling, separation or other distresses.

#### **37-3.02D Payment**

The payment quantity for slurry seal is the weight determined by combining the weights of the aggregate and asphaltic emulsion or polymeric asphaltic emulsion. The payment quantity for slurry seal does not include the weights of the added water and set-control additives.

### **37-3.03 MICRO-SURFACINGS**

#### **37-3.03A General**

##### **37-3.03A(1) Summary**

Section 37-3.03 includes specifications for applying micro-surfacings.

Applying a micro-surfacing consists of spreading a mixture of a micro-surfacing emulsion, water, additives, mineral filler, and aggregate on the pavement.

**37-3.03A(2) Definitions**

Reserved

**37-3.03A(3) Submittals**

Immediately after sampling, submit two 1-quart wide mouth plastic containers of micro-surfacing emulsion taken in the presence of the Engineer. Samples must be submitted in insulated shipping container.

**37-3.03A(4) Quality Assurance**

**37-3.03A(4)(a) General**

Reserved

**37-3.03A(4)(b) Quality Control**

**37-3.03A(4)(b)(i) General**

Reserved

**37-3.03A(4)(b)(ii) Micro-surfacing Emulsions**

Take samples from the truck tank at mid load from a sampling tap or thief. Before taking samples, draw and dispose of 1 gallon. In the presence of the Engineer, take two 1-quart wide mouth plastic containers for acceptance testing.

For a micro-surfacing emulsion, the authorized laboratory must perform quality control sampling and testing at the specified frequency and location for the quality characteristics shown in the following table:

**Micro-Surfacing Emulsion**

Quality characteristic	Test method	Minimum sampling and testing frequency	Sampling location
Tests on emulsion:			
Saybolt Furol Viscosity, at 25°C (Saybolt Furol seconds)	AASHTO T 59	Minimum 1 per day per delivery truck	Delivery truck
Storage stability, 1 day (max, %) <sup>a</sup>			
Sieve test (max, %)			
Residue by evaporation (min, %)	California Test 331	Minimum 1 per day per delivery truck	Delivery truck
Tests on residue from evaporation test:			
Penetration at 25 °C	AASHTO T 49	Minimum 1 per day per delivery truck	Delivery truck
Softening point (min, °C)	AASHTO T 53		

<sup>a</sup>Storage stability test will be run if the storage exceeds 48 hours

**37-3.03A(4)(c) Department Acceptance**

For micro-surfacing emulsions, acceptance is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

### Micro-surfacing Emulsion Acceptance Criteria

Quality characteristic	Test method	Requirement
Tests on emulsion:		
Saybolt Furol Viscosity at 25 °C (Saybolt Furol seconds)	AASHTO T 59	15–90
Sieve test (%)	AASHTO T 59	0.30
Storage stability, 1 day (max, %)	AASHTO T 59	0–1
Settlement <sup>a</sup> , 5 days (max, %)	ASTM D244	5
Residue by evaporation (min, %)	California Test 331	62
Tests on residue by evaporation:		
Penetration at 25 °C	AASHTO T 49	40–90
Softening point (min, °C)	AASHTO T 53	57

<sup>a</sup>Settlement test on emulsion is not required if used within 48 hours of shipment.

Acceptance of aggregate, except mineral filler, is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

### Aggregate Acceptance Criteria

Quality characteristic	Test method	Requirement
Los Angeles Rattler loss (max, %) At 500 revolutions	California Test 211 <sup>a</sup>	35
Percent of crushed particles (min, %)	California Test 205	95
Durability (min)	California Test 229	65
Sand equivalent (min)	California Test 217	
Type II		65
Type III		65

<sup>a</sup>California Test 211 must be performed on the aggregate before crushing. The aggregate supplier must certify that the crushed aggregate being used on the project is manufactured from the source aggregate complying with the LA rattler requirements.

An aggregate sand equivalent test represents 300 tons or 1 day's production, whichever is less.

If the test results for aggregate sand equivalent do not comply with the specifications, you may remove the micro-surfacing represented by the test results or request it remain in place with a payment deduction. If your request is authorized, the Department deducts \$2.00 per ton of micro-surfacing for each noncompliant aggregate sand equivalent test.

#### 37-3.03B Materials

##### 37-3.03B(1) General

Reserved

##### 37-3.03B(2) Micro-surfacing Emulsions

A micro-surfacing emulsion must be a homogeneous mixture of asphalt, an elastomeric polymer and an emulsifier solution.

Add an elastomeric polymer modifier to asphalt or emulsifier solution before emulsification. An elastomeric polymer solid must be a minimum of 3 percent by weight of the micro-surfacing emulsion's residual asphalt.

A micro-surfacing emulsion must comply with the requirements shown in the following table:

### Micro-surfacing Emulsion Requirements

Quality characteristic	Test method	Requirement
<b>Tests on emulsion:</b>		
Saybolt Furol Viscosity at 25 °C (Saybolt Furol seconds)	AASHTO T 59	15–90
Sieve test (%)	AASHTO T 59	0.30
Storage stability, 1 day (max, %)	AASHTO T 59	0–1
Settlement <sup>a</sup> , 5 days (max, %)	ASTM D244	5
Residue by evaporation (min, %)	California Test 331	62
<b>Tests on residue by evaporation:</b>		
Penetration at 25 °C	AASHTO T 49	40–90
Softening point (min, °C)	AASHTO T 53	57

<sup>a</sup>Settlement test on emulsion is not required if used within 48 hours of shipment.

### 37-3.03B(3) Aggregate

Aggregate must comply with the quality characteristic requirements shown in the following table:

#### Aggregate Requirements

Quality characteristic	Test method	Requirement
Los Angeles Rattler loss (max, %) At 500 revolutions	California Test 211 <sup>a</sup>	35
Percent of crushed particles (min, %)	California Test 205	95
Durability (min)	California Test 229	65
Sand equivalent (min)	California Test 217	
Type II		65
Type III		65

<sup>a</sup>California Test 211 must be performed on the source aggregate before crushing. The aggregate supplier must certify that the crushed aggregate being used on the project is manufactured from the source aggregate complying with the LA rattler requirements.

### 37-3.03B(4) Mineral Fillers

If a mineral filler is used, it must be type I or type II Portland cement. A mineral filler used during mix design must be used during production.

### 37-3.03B(5) Micro-Surfacing Mix Designs

The micro-surfacing mix design must have the material proportion limits shown in the following table:

#### Micro-surfacing Mix Design Proportion Limits

Material	Proportion limits
Micro-surfacing emulsion asphalt residual content (% of dry weight of aggregate)	5.5–10.5
Water and additives	As Required
Mineral filler (% of dry weight of aggregate)	0–3

The micro-surfacing mix design must comply with the requirements shown in the following table:

### Micro-surfacing Mix Design Requirements

Quality characteristics	Test method <sup>a</sup>	Requirement
Wet cohesion At 30 minutes (set) (min, kg-cm) At 60 minutes (traffic) (min, kg-cm)	Technical Bulletin 139	12 20
Excess asphalt (max, g/m <sup>2</sup> )	Technical Bulletin 109	540
Wet stripping (min, %)	Technical Bulletin 114	90
Wet track abrasion loss 6-day soak (max, g/m <sup>2</sup> )	Technical Bulletin 100	810
Displacement Lateral (max, %) Specific gravity after 1000 cycles of 57 kg (max)	Technical Bulletin 147A	5 2.10
Classification compatibility (min, grade points)	Technical Bulletin 144	(AAA, BAA) 11
Mix time at 25 °C (min)	Technical Bulletin 113	Controllable to 120 seconds

<sup>a</sup>Test methods are by the International Slurry Surfacing Association.

#### 37-3.03B(6) Tack Coats

If there is a bid item for tack coat, you must coat the pavement surface with an asphaltic emulsion mixed with additional water before applying a micro-surfacing. The maximum ratio of water to asphaltic emulsion must be 2 to 1. Apply the tack coat at a rate from 0.08 to 0.15 gal/sq yd. The exact rate must be authorized.

You determine the grade of slow-setting or quick setting asphaltic emulsion to be used.

#### 37-3.03C Construction

##### 37-3.03C(1) General

Reserved

##### 37-3.03C(2) Proportioning

Field conditions may require adjustments to the proportions within the authorized mix design during construction.

##### 37-3.03C(3) Mixing and Spreading Equipment

###### 37-3.03C(3)(a) General

Reserved

###### 37-3.03C(3)(b) Scratch Course Boxes

Spread the scratch courses with the same type of spreader box used to spread micro-surfacings except use an adjustable steel strike-off device instead of a final strike-off device.

###### 37-3.03C(3)(c) Wheel Path Depression Boxes

Each wheel path depression box must have adjustable strike-off device between 5 and 6 feet wide to regulate depth. The wheel path depression box must also have devices such as hydraulic augers capable of:

1. Moving the mixed material from the rear to the front of the filling chamber
2. Guiding larger aggregate into the deeper section of the wheel path depression
3. Forcing the finer material towards the outer edges of the spreader box

###### 37-3.03C(4) Test Strips

If micro-surfacing placement will require more than 1 day, you must construct a test strip. The test strip must be:

1. From 300 to 450 feet long
2. The same as the full production micro-surfacing
3. On 1 of the application courses specified at an authorized location

4. At the same time of day or night the full production micro-surfacing is to be applied

If multiple application courses are specified, you may construct test strips over 2 days or nights.

The Engineer evaluates the test strip after traffic has used it for 12 hours. If the Engineer determines the mix design or placement procedure is unacceptable, make modifications and construct a new test strip for the Engineer's evaluation.

**37-3.03C(5) Placement**

**37-3.03C(5)(a) General**

Reserved

**37-3.03C(5)(b) Repair Wheel Path Depressions**

If repairing wheel path depressions is shown in plans, fill wheel path depressions and irregularities with micro-surfacing material before spreading micro-surfacing. If the depressions are less than 0.04 foot deep, fill with a scratch course. If the depressions are 0.04 foot deep or more, fill the depressions using a wheel path depression box.

Spread scratch courses by adjusting the steel strike-off of a scratch course box until it is directly in contact with the pavement surface.

Spread micro-surfacings with a wheel path depression box leaving a slight crown at the surface. Use multiple applications to fill depressions more than 0.12 foot deep. Do not apply more than 0.12 foot in a single application.

Allow traffic to compact each filled wheel path depression for a minimum of 12 hours before placing additional micro-surfacings.

**37-3.03C(5)(c) Micro-surfacing Pavement Surfaces**

The micro-surfacing spread rates must be within the ranges shown in the following table:

Micro-surfacing type	Application range (lb of dry aggregate/sq yd)
Type II	10–20
Type III <sup>a</sup>	20–32
Type III <sup>b</sup>	30–32

<sup>a</sup>Over asphalt concrete pavement

<sup>b</sup>Over concrete pavement and concrete bridge decks

Within 2 hours after placement, micro-surfacings must be set enough to allow traffic without pilot cars. Protect the micro-surfacings from damage until it has set and will not adhere or be picked up by vehicle tires. Micro-surfacings must not exhibit distress from traffic such as bleeding, raveling, separation or other distresses.

**37-3.03D Payment**

The payment quantity for micro-surfacing is the weight determined by combining the weights of the aggregate and micro-surfacing emulsion. The payment quantity for micro-surfacing does not include the weights of added water, mineral filler, and additives.

**37-3.04 RUBBERIZED AND MODIFIED SLURRY SEALS**

Reserved

**37-4 FOG SEALS AND FLUSH COATS**

**37-4.01 GENERAL**

**37-4.01A General**

**37-4.01A(1) Summary**

Section 37-4.01 includes general specifications for applying fog seals and flush coats.

### **37-4.01A(2) Definitions**

Reserved

### **37-4.01A(3) Submittals**

At least 15 days before use, submit:

1. Sample of asphaltic emulsion in two 1-quart plastic container with lined, sealed lid
2. Asphaltic emulsion information and test data as follows:
  - 2.1. Supplier
  - 2.2. Type/Grade of asphalt emulsion
  - 2.3. Copy of the specified test results for asphaltic emulsion

### **37-4.01B Materials**

Not Used

### **37-4.01C Construction**

#### **37-4.01C(1) General**

Reserved

#### **37-4.01C(2) Weather Conditions**

Only place a fog seal or flush coat if both the pavement and ambient temperatures are at least 50 degrees F and rising. Do not place a fog seal or flush coat within 24 hours of rain or within 24 hours of forecast rain or freezing temperatures.

#### **37-4.01D Payment**

Not Used

### **37-4.02 FOG SEALS**

#### **37-4.02A General**

##### **37-4.02A(1) Summary**

Section 37-4.02 includes specifications for applying fog seals.

Applying a fog seal includes applying a diluted slow-setting or quick setting asphaltic emulsion.

##### **37-4.02A(2) Definitions**

Reserved

##### **37-4.02A(3) Submittals**

Immediately after sampling, submit two 1-quart plastic container of asphaltic emulsion taken in the presence of the Engineer. Samples must be submitted in insulated shipping container.

##### **37-4.02A(4) Quality Assurance**

###### **37-4.02A(4)(a) General**

Reserved

###### **37-4.02A(4)(b) Quality Control**

###### **37-4.02A(4)(b)(i) General**

Reserved

###### **37-4.02A(4)(b)(ii) Asphaltic Emulsions**

Circulate asphaltic emulsions in the distributor truck before sampling. Take samples from the distributor truck at mid load or from a sampling tap or thief. Before taking samples, draw and dispose of 1 gallon. In the presence of the Engineer, take asphalt emulsion sample in two 1-quart plastic container with lined, sealed lid.

For asphaltic emulsions, the authorized laboratory must perform quality control sampling and testing at the specified frequency and location for the following quality characteristics:

### Asphaltic Emulsion

Quality characteristic	Test Method	Minimum sampling and testing frequency	Sampling location
Saybolt Furol Viscosity, at 25 °C (Saybolt Furl seconds)	AASHTO T 59	Minimum 1 per day per delivery truck	Distributor truck
Sieve Test (%)			
Storage stability, 1 day (%)			
Residue by distillation (%)			
Particle charge <sup>a</sup>			
Tests on Residue from Distillation Test:			
Penetration, 25 °C	AASHTO T 49	Minimum 1 per day per delivery truck	Distributor truck
Ductility	AASHTO T 51		
Solubility in trichloroethylene	AASHTO T 44		

<sup>a</sup>If the result of the particle charge is inconclusive, the asphaltic emulsion must be tested for pH under ASTM E70. Grade QS1h asphaltic emulsion must have a minimum pH of 7.3. Grade CQS1h asphaltic emulsion must have a maximum pH of 6.7.

#### 37-4.02A(4)(b)(iii) Asphaltic Emulsion Spread Rates

For fog seals, the authorized laboratory must perform sampling and testing at the specified frequency and location for the following quality characteristics:

#### Fog Seal Quality Control Requirements

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Asphaltic emulsion spread rate (gal/sq yd)	California Test 339	2 per day	Pavement surface

#### 37-4.02A(4)(c) Department Acceptance

Fog seal acceptance is based on:

1. Visual inspection for the following:
  - 1.1. Uniform surface texture throughout the work limits
  - 1.2. Flushing consisting of the occurrence of a film of asphaltic material on the surface
  - 1.4. Streaking consisting of alternating longitudinal bands of asphaltic emulsion approximately parallel with the lane line
2. The Department's sampling and testing for compliance with the requirements for the quality characteristics specified in section 94 for asphaltic emulsion
3. Department's sampling and testing for compliance with the requirements for fog seal shown in the following table:

#### Fog Seal Acceptance Criteria

Quality Characteristic	Test Method	Requirement
Asphaltic emulsion spread rate (gal/sq yd)	California Test 339	TV ± 10%

#### 37-4.02B Materials

You determine the grade of slow-setting or quick setting asphaltic emulsion to be used.

#### 37-4.02C Construction

Apply asphaltic emulsions for fog seals at a residual asphalt rate from 0.02 to 0.06 gal/sq yd.

If additional water is added to the asphaltic emulsions, the resultant mixture must not be more than 1 part asphaltic emulsion to 1 part water. You determine the dilution rate.

If the fog seals become tacky, sprinkle water as required.



If fog seals and chip seals are on the same project, the joint between the seal coats must be neat and uniform.

**37-4.02D Payment**

The Department does not adjust the unit price for an increase or decrease in the asphaltic emulsion quantity.

**37-4.03 FLUSH COATS**

**37-4.03A General**

**37-4.03A(1) Summary**

Section 37-4.03 includes specifications for applying flush coats.

Applying a flush coat includes applying a fog seal coat followed by sand.

**37-4.03A(2) Definitions**

Reserved

**37-4.03A(3) Submittals**

At least 15 days before use, submit:

1. Proposed target X values for sand gradation.
2. Gradation test results for sand

Submit quality control test results for sand gradation within 2 business days of sampling.

**37-4.03A(4) Quality Assurance**

**37-4.03A(4)(a) General**

Reserved

**37-4.03A(4)(b) Quality Control**

For sand, the authorized laboratory must perform sampling and testing at the specified frequency and location for the following quality characteristics:

**Sand Quality Control**

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Gradation (% passing by weight)	California Test 202	1 per day	See California Test 125

**37-4.03A(4)(c) Department Acceptance**

Flush coat acceptance is based on fog seal acceptance and the following:

1. Visual inspection for uniform application of sand.
2. Sand acceptance is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

### Sand Gradation Acceptance Criteria

Quality characteristic	Test method	Requirement
Gradation (% passing by weight)	California Test 202	
Sieve size:		
3/8"		100
No. 4		93–100
No. 8		61–99
No. 16		X ± 13
No. 30		X ± 12
No. 50		X ± 9
No.100		1–15
No. 200	0–10	

NOTE: "X" is the gradation that you propose to furnish for the specific sieve size.

#### 37-4.03B Material

##### 37-4.03B(1) General

Reserved

##### 37-4.03B(2) Sand

Sand must be free from deleterious coatings, clay balls, roots, bark, sticks, rags, and other extraneous material.

Sand for a flush coat must comply with the gradations shown in the following table:

#### Sand Gradation

Quality characteristic	Test method	Requirement
Gradation (% passing by weight)	California Test 202	
Sieve size:		
3/8"		100
No. 4		93–100
No. 8		61–99
No. 16		X ± 13
No. 30		X ± 12
No. 50		X ± 9
No.100		1–15
No. 200	0–10	

NOTE: "X" is the gradation that you propose to furnish for the specific sieve size.

Fine aggregate sizes must be distributed such that the difference between the total percentage passing the No. 16 and No. 30 sieves is from 10 to 40, and the difference between the percentage passing the No. 30 and No. 50 sieves is from 10 to 40.

#### 37-4.03C Construction

##### 37-4.03C(1) General

During flush coat activities, close adjacent lanes to traffic. Do not track asphaltic emulsion on existing pavement surfaces.

Apply sand immediately after applying asphaltic emulsions.

Spread sand aggregate with a mechanical device that spreads sand at a uniform rate over the full width of a traffic lane in a single application. Spread sand at a rate from 2 to 6 lb/sq yd. You determine the application rates for sand and the Engineer authorizes the application rate.

##### 37-4.03C(2) Sweeping

Sweep loose sand material remaining on the surface 24 hours after application.

### **37-4.03D Payment**

The Department does not adjust the unit price for an increase or decrease in the sand cover (seal) quantity.

## **37-5 PARKING AREA SEALS**

### **37-5.01 GENERAL**

#### **37-5.01A Summary**

Section 37-5 includes specifications for applying parking area seals. Sealing a parking area consists of spreading a mixture of asphaltic emulsion, aggregate, polymer, and water.

#### **37-5.01B Definitions**

Reserved

#### **37-5.01C Submittals**

At least 15 days before starting placement, submit a 20 lb sample of the aggregate to be used.

At least 10 days before starting placement, submit:

1. Name of the authorized laboratory to perform testing and mix design.
2. Laboratory report of test results and a proposed mix design. The report and mix design must include the specific materials to be used and show a comparison of test results and specifications. The mix design report must include the quantity of water allowed to be added at the job site. The authorized laboratory performing the tests must sign the original laboratory report and mix design.
3. Manufacturer's data for oil seal primer and polymer.

If the mix design consists of the same materials covered by a previous laboratory report, you may submit the previous laboratory report that must include material testing data performed within the previous 12 months for authorization.

If you request substitute materials, submit a new laboratory report and mix design at least 10 days before starting placement.

Submit a certificate of compliance for the parking area seal material.

Immediately after sampling, submit two 1-quart plastic containers of parking area seal taken in the presence of the Engineer. Samples must be submitted in insulated shipping containers.

#### **37-5.01D Quality Assurance**

##### **37-5.01D(1) General**

Reserved

##### **37-5.01D(2) Quality Control**

###### **37-5.01D(2)(a) General**

Reserved

###### **37-5.01D(2)(b) Asphaltic Emulsions**

For an asphaltic emulsion, the authorized laboratory must perform quality control sampling and testing at the specified frequency and location for the following quality characteristics:

### Asphaltic Emulsion

Quality characteristic	Test Method	Minimum sampling and testing frequency	Sampling location
Saybolt Furol Viscosity, at 25 °C (Saybolt Furol seconds)	AASHTO T 59	Minimum 1 per day per delivery truck	Distributor truck
Sieve Test (%)			
Storage stability, 1 day (%)			
Residue by distillation (%)			
Particle charge <sup>a</sup>			
Tests on Residue from Distillation Test			
Penetration, 25 °C	AASHTO T 49	Minimum 1 per day per delivery truck	Distributor truck
Ductility	AASHTO T 51		
Solubility in trichloroethylene	AASHTO T 44		

<sup>a</sup>If the result of the particle char is inconclusive, the asphaltic emulsion must be tested for pH under ASTM E70. Grade QS1h asphaltic emulsion must have a minimum pH of 7.3. Grade CQS1h asphaltic emulsion must have a maximum pH of 6.7.

### 37-5.01D(2)(c) Sand

For sand, the authorized laboratory must perform sampling and testing at the specified frequency and location for the following quality characteristics:

#### Sand Quality Control

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Gradation (% passing by weight)	California Test 202	One per project	See California Test 125

### 37-5.01D(2)(d) Parking Area Seals

For a parking area seal, the authorized laboratory must perform quality control sampling and testing at the specified frequency for the following quality characteristics:

#### Parking Area Seal Requirements

Quality characteristic	Test method	Frequency
Mass per liter (kg)	ASTM D244	One per project
Cone penetration (mm)	California Test 413	
Nonvolatile (%)	ASTM D2042 <sup>a</sup>	
Nonvolatile soluble in trichloroethylene (%)		
Wet track abrasion (g/m <sup>2</sup> )	ASTM D3910	
Dried film color	--	
Viscosity (KU) <sup>b</sup>	ASTM D562	

<sup>a</sup>Weigh 10 g of homogenous material into a previously tarred, small can. Place in a constant temperature oven at 165 ± 5 °C for 90 ± 3 minutes. Cool, reweigh, and calculate nonvolatile components as a percent of the original weight.

<sup>b</sup>Krebs units

### 37-5.01D(3) Department Acceptance

Parking area seal acceptance is based on:

1. Visual inspection for:
  - 1.1. Uniform surface texture throughout the work limits
  - 1.2. Marks in the surface:
    - 1.2.1. Up to 4 marks in the completed parking area seal that are up to 1 inch wide and up to 6 inches long per 1,000 square feet of parking area seal placed.
    - 1.2.2. No marks in the completed parking area seal surface that are over 1 inch wide or 6 inches long.

- 1.2. Raveling consisting of the separation of the aggregate from the asphaltic emulsion
- 1.3. Bleeding consisting of the occurrence of a film of asphaltic material on the surface of the parking area seal
- 1.4. Delaminating of the parking area seal from the existing pavement
- 1.5. Rutting or wash-boarding
2. The Department's sampling and testing of aggregate for compliance with 100 percent passing no. 16 sieve under California Test 202
3. The Department's sampling and testing for compliance with the requirements shown in the following table:

**Parking Area Seal Acceptance Criteria**

Quality characteristic	Test method	Requirement
Mass per liter (min, kg)	ASTM D244	1.1
Cone penetration (mm)	California Test 413	340–700
Nonvolatile (min, %)	ASTM D2042 <sup>a</sup>	50
Nonvolatile soluble in trichloroethylene (%)		10–35
Wet track abrasion (max, g/m <sup>2</sup> )	ASTM D3910	380
Dried film color	--	Black
Viscosity (min, KU) <sup>b</sup>	ASTM D562	75

<sup>a</sup>Weigh 10 g of homogenous material into a previously tared, small ointment can. Place in a constant temperature oven at 165 ± 5 °C for 90 ± 3 minutes. Cool, reweigh, and calculate nonvolatile components as a percent of the original weight.

<sup>b</sup>Krebs units

## **37-5.02 MATERIALS**

### **37-5.02A General**

Aggregate must be clean, hard, durable, uncoated, and free from organic and deleterious substances. One hundred percent of the aggregate must pass the no. 16 sieve.

Asphaltic emulsion must be either Grade SS1h or CSS1h, except the values for penetration at 25 degrees C for tests on residue from distillation must be from 20 to 60.

Polymer must be either neoprene, ethylene vinyl acetate, or a blend of butadiene and styrene.

Oil seal primer must be a quick-drying emulsion with admixtures. Oil seal primer must be manufactured to isolate the parking area seal from pavement with residual oils, petroleum grease, and spilled gasoline.

Crack sealant must comply with section 37-6.

Water must be potable and not separate from the emulsion before the material is placed.

### **37-5.02B Mix Design**

The proposed mix design for a parking area seal must comply with the requirements shown in the following table:

### Parking Area Seal Mix Design Requirements

Quality characteristic	Test method	Requirement
Mass per liter (min, kg)	ASTM D244	1.1
Cone penetration (mm)	California Test 413	340–700
Nonvolatile (min, %)	ASTM D2042 <sup>a</sup>	50
Nonvolatile soluble in trichloroethylene (%)		10–35
Wet track abrasion (max, g/m <sup>2</sup> )	ASTM D3910	380
Dried film color	--	Black
Viscosity (min, KU) <sup>b</sup>	ASTM D562	75

<sup>a</sup>Weigh 10 g of homogenous material into a previously tarred, small ointment can. Place in a constant temperature oven at 165 ± 5 °C for 90 ± 3 minutes. Cool, reweigh, and calculate nonvolatile components as a percent of the original weight.

<sup>b</sup>Krebs units

A parking area seal must contain a minimum of 2 percent polymer by volume of undiluted asphaltic emulsion.

#### 37-5.02C Proportioning

Parking area seal ingredients must be mixed at a central plant. The plant must include mechanical or electronic controls that consistently proportion the ingredients. Mix an asphaltic emulsion with the other ingredients mechanically.

Store the parking area seal in a tank equipped with mixing or agitation devices. Keep stored materials thoroughly mixed. Protect stored materials from freezing conditions.

#### 37-5.03 CONSTRUCTION

##### 37-5.03A General

Request that the Engineer shut off the irrigation control system at least 5 days before placing the seal. Do not water plants adjacent to the seal at least 24 hours before and after the seal coat placement.

##### 37-5.03B Surface Preparations

If cracks in the existing pavement are from 1/4 to 1 inch wide, treat the cracks under section 37-6. Do not place the parking area seals until the Engineer determines that the crack treatments are cured.

If cracks in the existing pavement are greater than 1 inch wide, the Engineer orders the repair. This work is change order work.

After any crack treatment and before placing parking area seals, clean the pavement surface, including removal of oil and grease spots. Do not use solvents.

If cleaning the pavement with detergents, thoroughly rinse with water. Allow all water to dry before placing parking area seals.

You must seal oil and grease spots that remain after cleaning. Use an oil seal primer and comply with the manufacturer's instructions.

If the existing pavement has oil and grease spots that do not come clean and sealing is insufficient, the Engineer orders the repair of the pavement. This work is change order work.

Before placing the parking area seals, dampen the pavement surface using a distributor truck. Place the seal on the damp pavement but do not place it with standing water on the pavement.

##### 37-5.03C Placement

If adding water at the job site based on the manufacturer's instructions for consistency and spreadability, do not exceed 15 percent by volume of undiluted asphaltic emulsion.

Place the parking area seals in 1 or more application. The seals must be uniform and smooth, free of ridges or uncoated areas.

If placing in multiple applications, allow the last application to thoroughly dry before the subsequent application.

Do not allow traffic on the parking area seals for at least 24 hours after placement.

Do not stripe over the parking area seals until it is dry.

#### **37-5.04 PAYMENT**

The payment quantity for parking area seal is the weight determined by combining the weights of the aggregate and asphaltic emulsion. The payment quantity for parking area seal does not include the added water and set-control additive.

### **37-6 CRACK TREATMENTS**

#### **37-6.01 GENERAL**

##### **37-6.01A Summary**

Section 37-6 includes specifications for treating cracks in asphalt concrete pavement.

##### **37-6.01B Definitions**

Reserved

##### **37-6.01C Submittals**

If your selected crack treatment material is on the Authorized Material List for flexible pavement crack treatment material, submit a certificate of compliance including:

1. Manufacturer's name
2. Production location
3. Brand or trade name
4. Designation
5. Batch or lot number
6. Crack treatment material type
7. Contractor or subcontractor name
8. Contract number
9. Lot size
10. Shipment date
11. Manufacturer's signature

If your selected crack treatment material is not on the Authorized Material List for flexible pavement crack treatment material, submit a sample and test results from each batch or lot 20 days before use. Testing must be performed by an authorized laboratory and test results must show compliance with the specifications. Test reports must include the information specified for the certificate of compliance submittal. Each hot-applied crack treatment material sample must be a minimum of 3 lb and submitted in a silicone release container. Each cold-applied crack treatment material sample must be a minimum of 2 quarts and submitted in a plastic container.

At least 10 days before the start of work, submit sand gradation test results under California Test 202.

Submit the following with each delivery of crack treatment material to the job site:

1. Manufacturer's heating and application instructions
2. Manufacturer's SDS
3. Name of the manufacturer's recommended detackifying agent

##### **37-6.01D Quality Assurance**

###### **37-6.01D(1) General**

Hot-applied crack treatment material must be sampled at least once per project in the Engineer's presence. Collect two 3-pounds-minimum samples of crack treatment material from the dispensing wand into silicone release boxes.

Cold-applied crack treatment material must be sampled at least once per project in the Engineer's presence. Collect 2 samples of crack treatment material from the dispensing wand into 1-quart containers.

**37-6.01D(2) Quality Control**

Reserved

**37-6.01D(3) Department Acceptance**

Crack treatment acceptance is based on:

1. Visual inspection for uniform filling of cracks throughout the work limits including:
  - 1.2. Crack treatment is not more than a 1/4 inch below the specified level
  - 1.3. Sealant failures
  - 1.4. Crack re-opening
  - 1.5. Crack overbanding is less than 3 inches wide
2. The Department's sampling and testing for compliance with the requirements shown in the following table:

**Crack Treatment Acceptance Criteria**

Quality characteristic <sup>a</sup>	Test method <sup>b</sup>	Requirement				
		Type 1	Type 2	Type 3	Type 4	Type 5
Softening point (min, °C)	ASTM D36	102	96	90	84	84
Cone penetration at 77 °F (max)	ASTM D5329	35	40	50	70	90
Resilience at 77 °F, unaged (%)	ASTM D5329	20–60	25–65	30–70	35–75	40–80
Flexibility(°C) <sup>c</sup>	ASTM D3111	0	0	0	-11	-28
Tensile adhesion (min, %)	ASTM D5329	300	400	400	500	500
Specific gravity (max)	ASTM D70	1.25	1.25	1.25	1.25	1.25
Asphalt compatibility	ASTM D5329	Pass	Pass	Pass	Pass	Pass
Sieve test (% passing)	See note d	100	100	100	100	100

<sup>a</sup>Cold-applied crack treatment material residue collected under ASTM D6943, Method B and sampled under ASTM D140 must comply with the grade specified.

<sup>b</sup>Except for viscosity, cure each specimen at a temperature of 23 ± 2 °C and a relative humidity of 50 ± 10 percent for 24 ± 2 hours before testing.

<sup>c</sup>For the flexibility test, the specimen size must be 6.4 ± 0.2 mm thick by 25 ± 0.2 mm wide by 150 ± 0.5 mm long. The test mandrel diameter must be 6.4 ± 0.2 mm. The bend arc must be 180 degrees. The bend rate must be 2 ± 1 seconds. At least 4 of 5 test specimens must pass at the specified test temperature without fracture, crazing, or cracking.

<sup>d</sup>For hot-applied crack treatment, dilute with toluene and sieve through a no. 8 sieve. For cold-applied crack treatment, sieve the material as-received through a no. 8 sieve. If the manufacturer provides a statement that added components passed the no. 16 sieve before blending, this requirement is void.

**37-6.02 MATERIALS**

**37-6.02A General**

Reserved

**37-6.02B Crack Treatment Material**

A crack treatment material must comply with the requirements shown in the following table:



### Crack Treatment Material

Quality characteristic <sup>a</sup>	Test method <sup>b</sup>	Requirement				
		Type 1	Type 2	Type 3	Type 4	Type 5
Softening point (min, °C)	ASTM D36	102	96	90	84	84
Cone penetration at 77 °F (max)	ASTM D5329	35	40	50	70	90
Resilience at 77 °F, unaged (%)	ASTM D5329	20–60	25–65	30–70	35–75	40–80
Flexibility(°C) <sup>c</sup>	ASTM D3111	0	0	0	-11	-28
Tensile adhesion (min, %)	ASTM D5329	300	400	400	500	500
Specific gravity (max)	ASTM D70	1.25	1.25	1.25	1.25	1.25
Asphalt compatibility	ASTM D5329	Pass	Pass	Pass	Pass	Pass
Sieve test (% passing)	See note d	100	100	100	100	100

<sup>a</sup>Cold-applied crack treatment material residue collected under ASTM D6943, Method B and sampled under ASTM D140 must comply with the grade specifications.

<sup>b</sup>Except for viscosity, cure each specimen at a temperature of 23 ± 2 °C and a relative humidity of 50 ± 10 percent for 24 ± 2 hours before testing.

<sup>c</sup>For the flexibility test, the specimen size must be 6.4 ± 0.2 mm thick by 25 ± 0.2 mm wide by 150 ± 0.5 mm long. The test mandrel diameter must be 6.4 ± 0.2 mm. The bend arc must be 180 degrees. The bend rate must be 2 ± 1 seconds. At least 4 of 5 test specimens must pass at the specified test temperature without fracture, crazing, or cracking.

<sup>d</sup>For hot-applied crack treatment, dilute with toluene and sieve through a no. 8 sieve. For cold-applied crack treatment, sieve the material as-received through a no. 8 sieve. If the manufacturer provides a statement that added components passed the no. 16 sieve before blending, this requirement is void.

A crack treatment material must be delivered to the job site with the information listed below. If crack treatment material is delivered to the job site in containers, each container must be marked with the following information.

1. Manufacturer's name
2. Production location
3. Brand or trade name
4. Designation
5. Crack treatment trade name
6. Batch or lot number
7. Maximum heating temperature
8. Expiration date for cold application only

Hot-applied crack treatment must be delivered to the job site premixed in cardboard containers with meltable inclusion liners or in a fully meltable package.

Cold-applied crack treatment must have a minimum shelf life of 3 months from the date of manufacture.

#### 37-6.02C Sand

Sand applied to tacky crack treatment material must be clean, free of clay, and comply with the gradation shown in the following table:

#### Sand Gradation

Quality characteristic	Test method	Requirement
Gradation (% passing by weight)	California Test 202	
Sieve size:		
No. 4		100
No. 50		0–30
No. 200		0–5

#### 37-6.03 CONSTRUCTION

Treat cracks from 1/4 to 1 inch in width for the entire length of the crack. Fill or repair cracks wider than 1 inch as ordered. Filling cracks wider than 1 inch is change order work.



**Add to the table in the 4th paragraph of section 39-2.01A(1):**

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**Add to item 8 in the 4th paragraph of section 39-2.01A(3)(b)(i):**

07-15-16

, except lime supplier and source

**Replace the headings and paragraphs of section 39-2.01A(3)(i) with:**

01-15-16

**39-2.01A(3)(i) Reserved**

**Replace the 2nd sentence in the 3rd paragraph of section 39-2.01A(4)(b) with:**

01-15-16

Submit 3 parts and keep 1 part.

**Add between *single* and *test* in the 7th paragraph of section 39-2.01A(4)(i)(i):**

07-15-16

aggregate or HMA

**Replace the 1st paragraph of section 39-2.01B(2)(b) with:**

07-15-16

If the proposed JMF indicates that the aggregate is being treated with dry lime or lime slurry with marination, or the HMA with liquid antistrip, then testing the untreated aggregate under AASHTO T 283 and AASHTO T 324 is not required.

If HMA treatment is required or being used by the Contractor, determine the plasticity index of the aggregate blend under California Test 204.

**Add between *aggregate* and *with dry lime* in the 3rd and 4th paragraphs of section 39-2.01B(2)(b):**

07-15-16

blend

**Replace the 9th through 11th paragraphs of section 39-2.01B(8)(a) with:**

07-15-16

HMA must be produced at the temperatures shown in the following table:

**HMA Production Temperatures**

HMA compaction	Temperature (°F)
HMA	
Density based Method	≤ 325 305–325
HMA with WMA technology	
Density based Method	240–325 260–325

**Delete the 1st paragraph of section 39-2.01B(11).**

**Add after the 2nd paragraph of section 39-2.01B(11):**

For miscellaneous areas and dikes:

1. Choose the aggregate gradation from:
  - 1.1. 3/8-inch Type A HMA aggregate gradation
  - 1.2. 1/2-inch Type A HMA aggregate gradation
  - 1.3. 1/2-inch dike mix aggregate gradation
2. Choose asphalt binder Grade PG 64-10, PG 64-16 or PG 70-10.
3. Minimum asphalt binder content must be:
  - 3.1. 6.40 percent for 3/8-inch Type A HMA aggregate gradation
  - 3.2. 5.70 percent for 1/2-inch Type A HMA aggregate gradation
  - 3.3. 6.40 percent for 1/2-inch dike mix aggregate gradation

If you request and the Engineer authorizes, you may reduce the minimum asphalt binder content.

Aggregate gradation for 1/2-inch dike mix must be within the TV limits for the specified sieve size shown in the following table:

**Aggregate Gradation for 1/2-inch Dike Mix  
(Percentage Passing)**

Sieve size	Target value limit	Allowable tolerance
3/4"	100	--
1/2"	90–95	TV ± 5
No. 4	70–75	TV ± 5
No. 8	23–25	TV ± 5
No. 50	15–35	TV ± 5
No. 200	7.0–13.0	TV ± 2.0

**Replace item 4 in the 2nd paragraph of section 39-2.01C(1) with:**

4. For method compaction:
  - 4.1. The temperature of the HMA and the HMA produced with WMA water injection technology in the windrow does not fall below 260 degrees F
  - 4.2. The temperature of the HMA produced using WMA additive technology in the windrow does not fall below 250 degrees F

**Delete item 3 in the 8th paragraph of section 39-2.01C(1).**

**Replace 39-2.01A(3)(m)(iv) in the 6th paragraph of section 39-2.01C(3)(e) with:**

36-3.01C(3)

**Replace 2.06 in the 4th paragraph of section 39-2.01C(3)(f) with:**

2.05

**Add to the end of section 39-2.01C(15)(b):**

The compacted lift thickness must not exceed 0.25 foot.

07-15-16

**Add between *rectangles* and *with* in the 4th paragraph of section 39-2.01C(16):**

, half the lane width,

04-15-16

**Add between *to* and *the* in item 1 of the 4th paragraph of section 39-2.01C(16):**

and along

04-15-16

**Delete *coat* in the 5th paragraph of section 39-2.01C(16).**

07-15-16

**Replace 37 in the 5th paragraph of section 39-2.01C(16) with:**

37-4.02

07-15-16

**Replace section 39-2.02A(3)(b) with:**

The JMF must be based on the superpave HMA mix design as described in *MS-2 Asphalt Mix Design Methods* by the Asphalt Institute.

01-15-16

**Add between the 1st and 2nd paragraphs of section 39-2.02C:**

If the ambient air temperature is below 60 degrees F, cover the loads in trucks with tarpaulins. If the time for HMA discharge to truck at the HMA plant until transfer to paver's hopper is 90 minutes or greater and if the ambient air temperature is below 70 degrees F, cover the loads in trucks with tarpaulins, unless the time from discharging to the truck until transfer to the paver's hopper or the pavement surface is less than 30 minutes. The tarpaulins must completely cover the exposed load until you transfer the mixture to the paver's hopper or the pavement surface.

07-15-16

**Replace the table in the 2nd paragraph of section 39-2.02C with:**

07-15-16

**Minimum Ambient Air and Surface Temperatures**

Lift thickness (feet)	Ambient air (°F)		Surface (°F)	
	Unmodified asphalt binder	Modified asphalt binder	Unmodified asphalt binder	Modified asphalt binder
Type A HMA and Type A HMA produced with WMA water injection technology				
<0.15	55	50	60	55
≥0.15	45	45	50	50
Type A HMA produced with WMA additive technology				
<0.15	45	45	50	45
≥0.15	40	40	40	40

**Delete the 3rd paragraph of section 39-2.02C.**

**Add between *HMA* and *placed* in the 1st sentence of the 4th paragraph of section 39-2.02C:**

07-15-16

and Type A HMA produced with WMA water injection technology

**Add between the 4th and the 5th paragraphs of section 39-2.02C:**

07-15-16

For Type A HMA produced with WMA additive technology placed under method compaction, if the asphalt binder is:

1. Unmodified, complete:
  - 1.1 1st coverage of breakdown compaction before the surface temperature drops below 240 degrees F
  - 1.2 Breakdown and intermediate compaction before the surface temperature drops below 190 degrees F
  - 1.3 Finish compaction before the surface temperature drops below 140 degrees F
  - 1.4 You may continue static rolling below 140 degrees F to remove roller marks.
2. Modified, complete:
  - 2.1 1st coverage of breakdown compaction before the surface temperature drops below 230 degrees F
  - 2.2 Breakdown and intermediate compaction before the surface temperature drops below 170 degrees F
  - 2.3 Finish compaction before the surface temperature drops below 130 degrees F
  - 2.4 You may continue static rolling below 130 degrees F to remove roller marks.

**Replace the 2nd paragraph of section 39-2.03A(3)(b) with:**

01-15-16

The JMF must be based on the superpave HMA mix design as described in *MS-2 Asphalt Mix Design Methods* by the Asphalt Institute.

**Replace the requirement in the row for *Voids in mineral aggregate on plant produced HMA* in the 2nd table in section 39-2.03A(4)(e)(i) with:**

01-15-16

18.0-23.0

**Add before the 1st paragraph of section 39-2.03A(4)(e)(ii)(C):**

04-15-16

CRM used must be on the Authorized Materials List for Crumb Rubber Modifier.

CRM must be a ground or granulated combination of scrap tire crumb rubber and high natural scrap tire crumb rubber, CRM must be 75.0 ± 2.0 percent scrap tire crumb rubber and 25.0 ± 2.0 percent high natural scrap tire crumb rubber by total weight of CRM. Scrap tire crumb rubber and high natural scrap tire crumb rubber must be derived from waste tires described in Pub Res Code § 42703.

**Replace the row for *Hamburg wheel track* in the table in section 39-2.03B(2) with:**

01-15-16

Hamburg wheel track (min, number of passes at the inflection point)	AASHTO T 324 (Modified) <sup>d</sup>	
Binder grade:		
PG 58		10,000
PG 64		12,500
PG 70		15,000

**Replace *RHMA-G* in the 3rd and 5th paragraphs of section 39-2.03C with:**

07-15-16

RHMA-G and RHMA-G produced with WMA water injection technology

**Add between the 5th and 6th paragraphs of section 39-2.03C:**

07-15-16

For RHMA-G produced with WMA additive technology placed under method compaction:

1. Complete the 1st coverage of breakdown compaction before the surface temperature drops below 260 degrees F
2. Complete breakdown and intermediate compaction before the surface temperature drops below 230 degrees F
3. Complete finish compaction before the surface temperature drops below 180 degrees F
4. You may continue static rolling below 140 degrees F to remove roller marks

**Replace the 6th and 7th paragraphs of section 39-2.04C with:**

07-15-16

For HMA-O and HMA-O produced with WMA water injection technology:

1. With unmodified asphalt binder:
  - 1.1. Spread and compact only if the atmospheric temperature is at least 55 degrees F and the surface temperature is at least 60 degrees F.
  - 1.2. Complete the 1st coverage using 2 rollers before the surface temperature drops below 240 degrees F.
  - 1.3. Complete all compaction before the surface temperature drops below 200 degrees F.
2. With modified asphalt binder, except asphalt rubber binder:
  - 2.1. Spread and compact only if the atmospheric temperature is at least 50 degrees F and the surface temperature is at least 50 degrees F.
  - 2.2. Complete the 1st coverage using 2 rollers before the surface temperature drops below 240 degrees F.
  - 2.3. Complete all compaction before the surface temperature drops below 180 degrees F.

For HMA-O produced with WMA additive technology:

1. With unmodified asphalt binder:
  - 1.1. Spread and compact only if the atmospheric temperature is at least 45 degrees F and the surface temperature is at least 50 degrees F.
  - 1.2. Complete the 1st coverage using 2 rollers before the surface temperature drops below 230 degrees F.
  - 1.3. Complete all compaction before the surface temperature drops below 190 degrees F.
2. With modified asphalt binder, except asphalt rubber binder:
  - 2.1. Spread and compact only if the atmospheric temperature is at least 40 degrees F and the surface temperature is at least 40 degrees F.
  - 2.2. Complete the 1st coverage using 2 rollers before the surface temperature drops below 230 degrees F.

2.3. Complete all compaction before the surface temperature drops below 170 degrees F.

**Replace *RHMA-O* and *RHMA-O-HB* in the 8th paragraph of section 39-2.04C with:**

07-15-16

RHMA-O and RHMA-O produced with WMA water injection technology, and RHMA-O-HB and RHMA-O-HB produced with WMA water injection technology

**Add between the 8th and 9th paragraphs of section 39-2.04C:**

07-15-16

For RHMA-O produced with WMA additive technology and RHMA-O-HB produced with WMA additives technology:

1. Spread and compact if the ambient air temperature is at least 45 degrees F and the surface temperature is at least 50 degrees F
2. Complete the 1st coverage using 2 rollers before the surface temperature drops below 270 degrees F
3. Complete all compaction before the surface temperature drops below 240 degrees F

**Add to the 2nd paragraph of section 39-2.05A(3)(b):**

01-15-16

The material transfer vehicle must receive HMA directly from the truck.

**Replace *Table 6.1* at each occurrence in the table in section 39-2.05B(2) with:**

01-15-16

Table 8.1

**Replace *SP-2 Asphalt Mixture* in the 1st footnote in the table in the 2nd paragraph of section 39-2.05B(2)(b) with:**

01-15-16

*MS-2 Asphalt Mix Design Methods*

**Replace *Manual Series No. 2 (MS-2)* in the 1st footnote in the table in the 2nd paragraph of section 39-2.05B(2)(b) with:**

01-15-16

*MS-2 Asphalt Mix Design Methods*

**Replace 39-3.05 in the 1st paragraph of section 39-3.04A with:**

01-15-16

39-3.04

**Add to the end of section 39-3.04A:**

07-15-16

Schedule cold planing activities such that the pavement is cold planed, the HMA is placed, and the area is opened to traffic during the same work shift.

**Delete the 2nd sentence of the 1st paragraph in section 39-3.04C(4).**

07-15-16





**Delete *business* in item 6 in the list in the 8th paragraph of section 49-1.01D(4).**

07-15-16

**Add to the list in 9th paragraph of section 49-1.01D(4):**

07-15-16

3. Cut pile to the specified cut-off elevation after bearing acceptance criteria is provided by the Department

**Delete the 3rd paragraph of section 49-1.03.**

04-15-16

**Delete the 2nd paragraph of section 49-1.04.**

04-15-16

**Delete the 4th paragraph of section 49-2.01C(5).**

01-15-16

**Replace item 3 in the list in the 2nd paragraph of section 49-3.01A with:**

07-15-16

3. CISS concrete piles

**Add between *undisturbed material* and *in a dry* in the 1st paragraph of section 49-3.01C:**

07-15-16

, casing, or steel shell

**Replace the 2nd and 3rd paragraphs of section 49-3.01C with:**

07-15-16

Place and secure reinforcement. Securely block the reinforcement to provide the minimum clearance shown between the reinforcing steel cage and the sides of the drilled hole, casing, or steel shell.

Steel shells, casings, and drilled holes must be clean and free of debris before reinforcement and concrete are placed.

**Replace *dewatered* in the 4th paragraphs of section 49-3.01C with:**

07-15-16

drilled

**Add to section 49-3.02A(1):**

07-15-16

Permanent steel casing and driven steel shell must comply with section 49-2.02.

**Replace the paragraph of section 49-3.02A(2) with:**

07-15-16

**dry hole:** A drilled hole that requires no work to keep it free of water.

**dewatered hole:** A drilled hole that:

1. Accumulates no more than 12 inches of water at the bottom during a 1 hour period without any pumping from the hole.

2. Has no more than 3 inches of water at the bottom immediately before placing concrete.
3. Does not require temporary casing to control the groundwater.

**Replace item 8 in the list in the 1st paragraph of section 49-3.02A(3)(b) with:**

07-15-16

8. Drilling plan and sequence
9. Concrete sequence and placement plan
10. If inspection pipes are required, methods for ensuring the inspection pipes remain straight, undamaged, and properly aligned during concrete placement

**Replace 1 *business day* in the paragraph of section 49-3.02A(3)(d) with:**

07-15-16

2 business days

**Add to section 49-3.02A(3)(d):**

07-15-16

The log must:

1. Show the pile location, tip elevation, cutoff elevation, dates of excavation and concrete placement, total quantity of concrete placed, length and tip elevation of any casing, and details of any hole stabilization method and materials used.
2. Include an 8-1/2 by 11 inch graph of concrete placed versus depth of hole filled as follows:
  - 2.1. Plot the graph continuously throughout concrete placement. Plot the depth of drilled hole filled vertically with the pile tip at the bottom and the quantity of concrete placed horizontally.
  - 2.2. Take readings at each 5 feet of pile depth, and indicate the time of the reading on the graph.

**Add after the sentence in the paragraph of section 49-3.02A(3)(e):**

07-15-16

Allow 10 days for the review.

**Replace the 3rd sentence in the paragraph of section 49-3.02A(3)(f) with:**

07-15-16

Allow 10 days for the review and analysis of this report.

**Add after *rejected pile* in the 1st sentence in the 1st paragraph of section 49-3.02A(3)(g):**

07-15-16

to be mitigated

**Delete the 2nd paragraph of section 49-3.02A(3)(g).**

07-15-16

**Replace item 3 in the list in the 3rd paragraph of section 49-3.02A(3)(g) with:**

07-15-16

3. Step by step description of the mitigation work to be performed, including drawings if necessary. If the *ADSC Standard Mitigation Plan* is an acceptable mitigation method, include the most recent version. For the most recent version of the *ADSC Standard Mitigation Plan*, go to:  
<http://www.dot.ca.gov/hq/esc/geotech/ft/adscmitplan.htm>

**Replace the 2nd sentence in the paragraph of section 49-3.02A(3)(i) with:**

07-15-16

Allow 10 days for the review.

**Add to section 49-3.02A(3):**

07-15-16

**49-3.02A(3)(j) Certifications**

If synthetic slurry is used, submit as an informational submittal the names and certifications of your employees who are trained and certified by the synthetic slurry manufacturer.

**Add after *excavated hole* in the 1st sentence in the 3rd paragraph of section 49-3.02A(4)(c):**

07-15-16

lined with plastic

**Replace the 1st paragraph of section 49-3.02A(4)(d)(i) with:**

07-15-16

Section 49-3.02A(4)(d) applies to CIDH concrete piles except for piles (1) less than 24 inches in diameter or (2) constructed in dry or dewatered holes.

**Replace *gamma-gamma logging* in the 2nd paragraph of section 49-3.02A(4)(d)(i) with:**

07-15-16

GGL

**Replace the 1st sentence in the 3rd paragraph of section 49-3.02A(4)(d)(i) with:**

07-15-16

After notification by the Engineer of pile acceptance, fill the inspection pipes and cored holes with grout.

**Replace *gamma-gamma logging* in section 49-3.02A(4)(d)(ii) with:**

07-15-16

GGL

**Replace the 3rd and 4th paragraphs of section 49-3.02A(4)(d)(iii) with:**

07-15-16

The Department may perform CSL to determine the extent of the anomalies identified by GGL and to further evaluate a rejected pile for the presence of anomalies not identified by GGL. The pile acceptance test report will indicate if the Department intends to perform CSL and when the testing will be performed. Allow the Department 20 additional days for a total of 50 days to perform CSL and to provide supplemental results.

If authorized, you may perform testing on the rejected pile.

07-15-16

**Delete the 8th paragraph of section 49-3.02A(4)(d)(iii).**

**Add to the end of section 49-3.02A(4)(d)(iii):**

07-15-16

If the Engineer determines it is not feasible to repair the rejected pile, submit a mitigation plan for replacement or supplementation of the rejected pile.

**Add to section 49-3.02A(4):**

07-15-16

**49-3.02A(4)(e) Certifications**

If synthetic slurry is used, your employees who will be providing technical assistance in the slurry activities must be trained and certified by the synthetic slurry manufacturer to show their competency to perform inspection of slurry operations.

**Replace section 49-3.02B(4) with:**

07-15-16

**49-3.02B(4) Reserved**

**Replace *near* in the 3rd, 4th, and 5th paragraphs of section 49-3.02B(6)(b) with:**

07-15-16

within 2 feet of

**Replace *twice per shift* in item 2 in the 3rd paragraph of section 49-3.02B(6)(b) with:**

07-15-16

every 4 hours

**Delete the 7th and 8th paragraphs of section 49-3.02B(6)(b).**

07-15-16

**Delete the 3rd paragraph of section 49-3.02B(6)(c).**

07-15-16

**Replace *near* in item 2 in the 4th paragraph of section 49-3.02B(6)(c) with:**

07-15-16

within 2 feet of

**Replace item 5 in the 4th paragraph of section 49-3.02B(6)(c) with:**

07-15-16

5. After final cleaning and immediately before placing concrete.

**Replace section 49-3.02B(9) with:**

07-15-16

**49-3.02B(9) Inspection Pipes**

Inspection pipes must be schedule 40 PVC pipe complying with ASTM D1785 with a nominal pipe size of 2 inches.

Watertight PVC couplers complying with ASTM D2466 are allowed to facilitate pipe lengths in excess of those commercially available.

**Add to the beginning of section 49-3.02C(1):**

07-15-16

Unless otherwise authorized, drilling the hole and placing reinforcement and concrete in the hole must be performed in a continuous operation.

**Replace the 5th paragraph of section 49-3.02C(2) with:**

07-15-16

If slurry is used during excavation, maintain the slurry level at a height required to maintain a stable hole, but not less than 10 feet above the piezometric head.

**Replace the 1st sentence in the 9th paragraph of section 49-3.02C(2) with:**

07-15-16

Remove water that has infiltrated the dewatered hole before placing concrete, as required for dewatered hole.

**Replace the 1st sentence in the 10th paragraph of section 49-3.02C(2) with:**

07-15-16

If authorized, to control caving or water seepage, you may enlarge portions of the hole, backfill the hole with slurry cement backfill, concrete, or other material, and redrill the hole to the diameter shown.

**Replace the 4th paragraph of section 49-3.02C(3) with:**

07-15-16

Remove the temporary casing during concrete placement. Maintain the concrete in the casing at a level required to maintain a stable hole, but not less than 5 feet above the bottom of the casing, to prevent displacement of the concrete by material from outside the casing.

**Replace the 5th paragraph of section 49-3.02C(4) with:**

07-15-16

For a single CIDH concrete pile supporting a column:

1. If the pile and the column share the same reinforcing cage diameter, this cage must be accurately placed as shown
2. If the pile reinforcing cage is larger in diameter than the column cage:
  - 2.1. Maintain a clear horizontal distance of at least 3.5 inches between the two cages, if the concrete is placed under dry conditions
  - 2.2. Maintain a clear horizontal distance of at least 5 inches between the two cages if the concrete is placed under slurry
  - 2.3. The offset between the centerlines of the two cages must not exceed 6 inches

**Replace the paragraphs in section 49-3.02C(5) with:**

07-15-16

For acceptance testing, install and test vertical inspection pipes as follows:

1. Log the location of the inspection pipe couplers with respect to the plane of pile cutoff.
2. Cap each inspection pipe at the bottom. Extend the pipe from 3 feet above the pile cutoff to the bottom of the reinforcing cage. Provide a temporary top cap or similar means to keep the pipes clean before testing. If pile cutoff is below the ground surface or working platform, extend inspection pipes to 3 feet above the ground surface or working platform.
3. If any changes are made to the pile tip, extend the inspection pipes to the bottom of the reinforcing cage.
4. Install inspection pipes in a straight alignment and parallel to the main reinforcement. Securely fasten inspection pipes in place and provide protective measures to prevent misalignment or damage to the inspection pipes during installation of the reinforcement and placement of concrete in the hole. Construct CIDH concrete piles such that the relative distance of inspection pipes to vertical steel reinforcement remains constant.
5. After concrete placement is complete, fill inspection pipes with water to prevent debonding of the pipe.
6. Provide safe access to the tops of the inspection pipes.

7. After placing concrete and before requesting acceptance testing, test each inspection pipe in the Engineer's presence by passing a rigid cylinder through the length of pipe. The rigid cylinder must be 1-1/4-inch diameter by 4.5-foot long, weigh 12 pounds or less, and be able to freely pass down through the entire length of the pipe under its own weight and without the application of force.
8. When performing acceptance testing, inspection pipes must provide a 2-inch-diameter clear opening and be completely clean, unobstructed, and either dry or filled with water as authorized.
9. After acceptance testing is complete, completely fill the inspection pipes with water.

If the rigid cylinder fails to pass through the inspection pipe:

1. Completely fill the inspection pipes in the pile with water immediately.
2. Core a nominal 2-inch-diameter hole through the concrete for the entire length of the pile for each inspection pipe that does not pass the rigid cylinder. Coring must not damage the pile reinforcement.
3. Locate cored holes as close as possible to the inspection pipes they are replacing and no more than 5 inches clear from the reinforcement.

Core holes using a double wall core barrel system with a split tube type inner barrel. Coring with a solid type inner barrel is not allowed.

Coring methods and equipment must provide intact cores for the entire length of the pile.

Photograph and store concrete cores as specified for rock cores in section 49-1.01D(5).

The coring operation must be logged by an engineering geologist or civil engineer licensed in the State and experienced in core logging. Coring logs must comply with the Department's *Soil and Rock Logging, Classification, and Presentation Manual* for rock cores. Coring logs must include core recovery, rock quality designation of the concrete, locations of breaks, and complete descriptions of inclusions and voids encountered during coring.

The Department evaluates the portion of the pile represented by the cored hole based on the submitted coring logs and concrete cores. If the Department determines a pile is anomalous based on the coring logs and concrete cores, the pile is rejected.

**Replace item 2 in the list in the 2nd paragraph of section 49-3.02C(7) with:**

07-15-16

2. Extend at least 5 feet below the construction joint. If placing casing into rock or a dry hole, the casing must extend at least 2 feet below the construction joint.

**Add to the beginning of section 49-3.02C(9):**

07-15-16

**49-3.02C(9)(a) General**

**Replace the 2nd sentence of the 3rd paragraph of section 49-3.02C(9) with:**

04-15-16

Do not vibrate the concrete.

**Add after *concrete pump* in the 8th paragraph of section 49-3.02C(9):**

07-15-16

and slurry pump

**Replace item 3 in the list in the 11th paragraph of section 49-3.02C(9) with:**

07-15-16

3. Maintain the slurry level at a height required to maintain a stable hole, but not less than 10 feet above the piezometric head.

**Replace the 13th paragraph of section 49-3.02C(9) with:**

07-15-16

Maintain a log of concrete placement for each drilled hole.

**Replace 14th and 15th paragraphs of section 49-3.02C(9) with:**

07-15-16

If a temporary casing is used, maintain concrete placed under slurry at a level required to maintain a stable hole, but not less than 5 feet above the bottom of the casing. The withdrawal of the casing must not cause contamination of the concrete with slurry.

The equivalent hydrostatic pressure inside the casing must be greater than the hydrostatic pressure on the outside of the casing to prevent intrusion of water, slurry, or soil into the column of freshly placed concrete.

Remove scum, laitance, and slurry-contaminated concrete from the top of the pile.

**Add to section 49-3.02C(9):**

07-15-16

**49-3.02C(9)(b) Mineral Slurry**

Remove any caked slurry on the sides or bottom of hole before placing reinforcement.

If concrete is not placed immediately after placing reinforcement, the reinforcement must be removed and cleaned of slurry, the sides of the drilled hole must be cleaned of caked slurry, and the reinforcement again placed in the hole for concrete placement.

**49-3.02C(9)(c) Synthetic Slurry**

A manufacturer's representative must:

1. Provide technical assistance for the use of their material
2. Be at the job site before introduction of the synthetic slurry into the drilled hole
3. Remain at the job site until released by the Engineer

After the manufacturer's representative has been released by the Engineer, your employee certified by the manufacturer must be present during the construction of the pile under slurry.

**Replace the heading of section 49-3.03 with:**

07-15-16

**CAST-IN-STEEL SHELL CONCRETE PILING**

**Replace the 1st paragraph of section 49-3.03A(1) with:**

07-15-16

Section 49-3.03 includes specifications for constructing CISS concrete piles consisting of driven open-ended or closed-ended steel shells filled with reinforcement and concrete.

**Add to the end of section 49-3.03A(1):**

07-15-16

CISS concrete piles include Class 90 Alternative V and Class 140 Alternative V piles.

**Add to section 49-3.03A(3):**

01-15-16

Submit a Pile and Driving Data Form under section 49-2.01A(3)(a) if specified in the special provisions.



**Replace the paragraph of section 49-3.03D with:**

07-15-16

Furnish piling is measured along the longest side of the pile from the specified tip elevation shown to the plane of pile cutoff.

**Replace section 49-4.03 with:**

01-15-16

**49-4.03 CONSTRUCTION**

**49-4.03A General**

Reserved

**49-4.03B Drilled Holes**

Drill holes for steel soldier piles into natural foundation material. Drilled holes must be accurately located, straight, and true.

Furnish and place temporary casings or tremie seals where necessary to control water or to prevent caving of the hole.

Before placing the steel soldier pile, remove loose materials existing at the bottom of the hole after drilling operations have been completed.

Do not allow surface water to enter the hole. Remove all water in the hole before placing concrete.

If temporary casings are used, they must comply with section 49-3.02C(3).

**49-4.03C Steel Soldier Piles**

Plumb and align the pile before placing concrete backfill and lean concrete backfill. The pile must be at least 2 inches clear of the sides of the hole for the full length of the hole to be filled with concrete backfill and lean concrete backfill. Ream or enlarge holes that do not provide the clearance around steel piles.

Maintain alignment of the pile in the hole while placing backfill material.

Clean and prepare piles in anticipated heat affected areas before splicing steel piles or welding concrete anchors.



**50 PRESTRESSING CONCRETE**

07-15-16

**Add to the end of section 50-1.01C:**

07-15-16

**50-1.01C(8) Post-tensioning Jack Calibration Chart**

Submit the post-tensioning jack calibration plot.

**50-1.01C(9) Pretensioning Jack Calibration Chart**

For any pretensioning jack calibrated by an authorized laboratory, submit a certified calibration plot.

**Replace section 50-1.01D(2)(b) with:**

07-15-16

**50-1.01D(2)(b) Equipment and Calibration**

**50-1.01D(2)(b)(i) General**

Each jack body must be permanently marked with the ram area.

Each pressure gauge must be fully functional and have an accurately reading, clearly visible dial or display. The dial must be at least 6 inches in diameter and graduated in 100 psi increments or less.

Each load cell must be calibrated and have an indicator that can be used to determine the force in the prestressing steel.

The range of each load cell must be such that the lower 10 percent of the manufacturer's rated capacity is not used in determining the jacking force.

Each jack must be calibrated equipped with its gauges.

Mechanically calibrate the gauges with a dead weight tester or other authorized means before calibration of the jacking equipment.

**50-1.01D(2)(b)(ii) Post-tensioning**

Equip each hydraulic jack used to tension prestressing steel with 2 pressure gauges or 1 pressure gauge and a load cell. Only 1 pressure gauge must be connected to the jack during stressing.

Each jack used to tension prestressing steel permanently anchored at 25 percent or more of its specified minimum ultimate tensile strength must be calibrated by METS within 1 year of use and after each repair. You must:

1. Schedule the calibration of the jacking equipment with METS.
2. Verify that the jack and supporting systems are complete, with proper components, and are in good operating condition.
3. Provide labor, equipment, and material to (1) install and support the jacking and calibration equipment and (2) remove the equipment after the calibration is complete.
4. Plot the calibration results.

Each jack used to tension prestressing steel permanently anchored at less than 25 percent of its specified minimum ultimate tensile strength must be calibrated by an authorized laboratory within 180 days of use and after each repair.

**50-1.01D(2)(b)(iii) Pretensioning**

Each jack used to pretension prestressing steel must be calibrated, equipped with its gauges, by a laboratory on the Authorized Laboratory List within 1 year of use and after each repair.

Calibrate pretensioning jacks:

1. Under ASTM E4 using an authorized laboratory. Certification that the calibration is performed to ASTM accuracy is not required.
2. In the presence of the Engineer. Notify the Engineer at least 2 business days before calibrating the jack.
3. Using 3 test cycles. Average the forces from each test cycle at each increment.
4. To cover the load range used in the work.

Gauges for pretensioning jacks may:

1. Be electronic pressure indicators that display either:
  - 1.1. Pressure in 100 psi increments or less
  - 1.2. Load to 1 percent of the maximum sensor/indicator capacity or 2 percent of the maximum load applied, whichever is smaller
2. Have a dial less than 6 inches in diameter

Gauges displaying pressure must have been calibrated within 1 year of the jack calibration.

Each hydraulic jack used for pretensioning must be equipped with either 2 gauges or 1 gauge and a load cell or you must have a calibrated standby jack with its gauge present on site during stressing.

^^

## 51 CONCRETE STRUCTURES

07-15-16

### Add to the list in the 2nd paragraph of section 51-1.01A:

8. Pile extensions

04-15-16

9. Drainage inlets

07-15-16

### Add to the list in the 6th paragraph of section 51-1.01A:

7. Drainage inlets

07-15-16

### Add to section 51-1.02I:

Metal frames, covers, grates, and other miscellaneous iron and steel used with drainage inlets must comply with section 75-2.

07-15-16

### Add to section 51-1.03B:

You may use PC drainage inlets as an alternative to CIP drainage inlets.

07-15-16

### Add between the 10th and 11th paragraphs of section 51-1.03C(2)(a):

For drainage inlets, extend the outside forms at least 12 inches below the top of the inlet. You may place concrete against excavated earth below this depth except:

07-15-16

1. You must use full-depth outside forms or other protection when work activities or unstable earth may cause hazardous conditions or contamination of the concrete.
2. You must increase the wall thickness 2 inches if placing concrete against the excavated surface. The interior dimensions must be as shown.

### Add to section 51-1.03C(2)(b):

For drainage inlets, remove exterior forms to at least 12 inches below the final ground surface. Exterior forms below this depth may remain if their total thickness is not more than 1 inch.

07-15-16

### Add to the list in the 2nd paragraph of section 51-1.03F(2):

4. Interior and top surfaces of drainage inlets

07-15-16

### Add to section 51-1.04:

The payment quantity for structural concrete, drainage inlet is the volume determined from the dimensions shown for CIP drainage inlets.

07-15-16

### Add to section 51-4.01C(1):

For PC drainage inlets, submit field repair procedures and a patching material test sample before repairs are made. Allow 10 days for the Engineer's review.

07-15-16

**Add to section 51-4.01C(2)(a):**

07-15-16

For drainage inlets with oval or circular cross sections, submit shop drawings with calculations. Shop drawings and calculations must be sealed and signed by an engineer who is registered as a civil engineer in the State. Allow 15 days for the Engineer's review.

**Add to section 51-4.01D(3):**

07-15-16

The Engineer may reject PC drainage inlets exhibiting any of the following:

1. Cracks more than 1/32 inch wide
2. Nonrepairable honeycombed or spalled areas of more than 6 square inches
3. Noncompliance with reinforcement tolerances or cross sectional area shown
4. Wall, inlet floor, or lid less than minimum thickness
5. Internal dimensions less than dimensions shown by 1 percent or 1/2 inch, whichever is greater
6. Defects affecting performance or structural integrity

**Add to section 51-4.02C:**

07-15-16

Materials for PC drainage inlets must comply with the following:

1. Preformed flexible joint sealant must be butyl-rubber complying with ASTM C990
2. Resilient connectors must comply with ASTM C923
3. Sand bedding must comply with section 19-3.02F(2)
4. Bonding agents must comply with ASTM C1059/C1059, Type II

**Add to section 51-4.02D:**

07-15-16

**51-4.02D(8) Drainage Inlets**

PC units for drainage inlets must be rectangular, round, or oval in cross section, or any combination. Transitions from a rectangular grate opening to a round or oval basin must be made in not less than 8 inches. Provide means for field adjustment to meet final grade, paving, or surfacing.

If oval or circular shape cross-sections are furnished, they must comply with *AASHTO LRFD Bridge Design Specifications, Sixth Edition with California Amendments*.

Wall and slab thicknesses may be less than the dimensions shown by at most 5 percent or 3/16 inch, whichever is greater.

Reinforcement placement must not vary more than 1/2 inch from the positions shown.

**Add to section 51-4.03:**

07-15-16

**51-4.03H Drainage Inlets**

Repair PC drainage inlet sections to correct damage from handling or manufacturing imperfections before installation.

Center pipes in openings to provide a uniform gap. Seal gaps between the pipe and the inlet opening with nonshrink grout under the grout manufacturer's instructions. For systems designated as watertight, seal these gaps with resilient connectors.

Match fit keyed joints to ensure uniform alignment of walls and lids. Keys are not required at the inlet floor level if the floor is precast integrally with the inlet wall. Seal keyed joint locations with preformed butyl rubber joint sealant. You may seal the upper lid and wall joint with nonshrink grout.





### Nondestructive Testing for Steel Standards and Poles

Weld location	Weld type	Minimum required NDT
Circumferential splices around the perimeter of tubular sections, poles, and arms	CJP groove weld with backing ring	100% UT or RT
Longitudinal seam	CJP or PJP groove weld	Random 25% MT
Longitudinal seam within 6 inches of a circumferential splice	CJP groove weld	100% UT or RT
Welds attaching base plates, flange plates, pole plates, or mast arm plates to poles or arm tubes	CJP groove weld with backing ring and reinforcing fillet	$t \geq 5/16$ inch: 100% UT and 100% MT $t < 5/16$ inch: 100% MT after root weld pass and final weld pass
	External (top) fillet weld for socket-type connections	100% MT
Hand holes and other appurtenances	Fillet and PJP welds	MT full length on random 25% of all standards and poles

NOTE:  $t$  = pole or arm thickness

### Nondestructive Testing for Overhead Sign Structures

Weld location	Weld type	Minimum required NDT
Base plate to post	CJP groove weld with backing ring and reinforcing fillet	100% UT and 100% MT
Base plate to gusset plate	CJP groove weld	100% UT
Circumferential splices of pipe or tubular sections	CJP groove weld with backing ring	100% UT or RT
Split post filler plate welds	CJP groove weld with backing bar	100% UT or RT
Longitudinal seam weld for pipe posts	CJP groove weld	t < 1/4 inch: 100% MT t ≥ 1/4 inch: 100% UT or RT
	PJP groove weld	Random 25% RT
Chord angle splice weld	CJP groove weld with backing bar	100% UT or RT
Truss vertical, diagonal, and wind angles to chord angles	Fillet weld	Random 25% MT
Upper junction plate to chord (cantilever type truss)	Fillet weld	Random 25% MT
Bolted field splice plates (tubular frame type)	CJP groove weld	100% UT and 100% MT
Cross beam connection plates (lightweight extinguishable message sign)	Fillet weld	Random 25% MT
Arm connection angles (lightweight extinguishable message sign)	Fillet weld	100% MT
Mast arm to arm plate (lightweight extinguishable message sign)	CJP groove weld with backing ring	t ≥ 5/16 inch: 100% UT and 100% MT t < 5/16 inch: 100% MT after root weld pass and final weld pass
Post angle to post (lightweight extinguishable message sign)	Fillet weld	100% MT
Hand holes and other appurtenances	Fillet and PJP welds	MT full length on random 25% of all sign structures

NOTE: t = pole or arm thickness

#### 56-1.01D(2)(b)(ii) Ultrasonic Testing

For UT of welded joints with any members less than 5/16 inch thick or tubular sections less than 13 inches in diameter, the acceptance and repair criteria must comply with Clause 6.13.3.1 of AWS D1.1.

For UT of other welded joints, the acceptance and repair criteria must comply with Table 6.3 of AWS D1.1 for cyclically loaded nontubular connections.

After galvanization, perform additional inspection for toe cracks along the full length of all CJP groove welds at tube-to-transverse plate connections using UT.

When performing UT, use an authorized procedure under AWS D1.1, Annex S.

#### 56-1.01D(2)(b)(iii) Radiographic Testing

The acceptance criteria for radiographic or real time image testing must comply with AWS D1.1 for tensile stress welds.

#### 56-1.01D(2)(b)(iv) Longitudinal Seam Welds

The Engineer selects the random locations for NDT.

Grind the cover pass smooth at the locations to be tested.



If repairs are required in a portion of a tested weld, perform NDT on the repaired portion and on 25 percent of the untested portions of the weld. If more repairs are required, perform NDT on the entire weld.

**56-1.01D(3) Department Acceptance**

Reserved

**Replace section 56-2.01D(2)(b) with:**

Reserved

07-15-16

**Replace the 2nd sentence of the 1st paragraph of section 56-2.02F with:**

Manufactured pipe posts must comply with one of the following:

07-15-16

**Add to the list in the 1st paragraph of section 56-2.02F:**

4. ASTM A1085, Grade A

07-15-16

**Replace the 2nd paragraph of section 56-2.02F with:**

You may fabricate pipe posts from structural steel complying with ASTM A36/A36M, ASTM A709/A709M, Grade 36, or ASTM A572/A572M, Grades 42 or 50.

07-15-16

**Delete the last sentence in the 1st paragraph of section 56-2.02K(2).**

07-15-16

**Delete the 3rd paragraph of section 56-2.02K(2).**

07-15-16

**Replace the 2nd paragraph of section 56-2.02K(4) with:**

Safety cable at walkways must not be kinked, knotted, deformed, frayed, or spliced.

07-15-16

**Replace the 1st sentence of the paragraph in section 56-2.02K(5) with:**

The edges of handholes and other large post and arm openings must be ground smooth.

07-15-16

**Replace the heading of section 56-3 with:**

**56-3 STANDARDS, POLES, PEDESTALS, AND POSTS**

07-15-16

**Replace the paragraph in section 56-3.01A with:**

Section 56-3 includes general specifications for fabricating and installing standards, poles, pedestals, and posts.

07-15-16

**Replace section 56-3.01B(2)(b) with:**

07-15-16

Standards with handholes must comply with the following:

1. Include a UL-listed lug and 3/16-inch or larger brass or bronze bolt for attaching the bonding jumper for non-slip-base standards.
2. Attach a UL-listed lug to the bottom slip base plate with a 3/16-inch or larger brass or bronze bolt for attaching the bonding jumper for slip-base standards.

**Replace the 1st sentence of the 3rd paragraph of section 56-3.01C(2)(a) with:**

07-15-16

After each standard, pole, pedestal, and post is properly positioned, place mortar under the base plate.

**Replace the 2nd sentence of the 4th paragraph of section 56-3.01C(2)(a) with:**

07-15-16

The top of the foundation at curbs or sidewalks must be finished to curb or sidewalk grade.

**Replace the 10th paragraph of section 56-3.01C(2)(a) with:**

07-15-16

Except when located on a structure, construct foundations monolithically.

**Replace the 13th paragraph of section 56-3.01C(2)(a) with:**

07-15-16

Do not erect standards, poles, pedestals, or posts until the concrete foundation has cured for at least 7 days.

**Replace the 14th paragraph in section 56-3.01C(2)(a) with:**

07-15-16

The Engineer selects either the plumbing or raking technique for standards, poles, pedestals, and posts. Plumb or rake by adjusting the leveling nuts before tightening nuts. Do not use shims or similar devices. After final adjustments of both top nuts and leveling nuts on anchorage assemblies have been made and each standard, pole, pedestal, and post on the structure is properly positioned, tighten nuts as follows:

1. Tighten leveling nuts and top nuts, following a crisscross pattern, until bearing surfaces of all nuts, washers, and base plates are in firm contact.
2. Use an indelible marker to mark the top nuts and base plate with lines showing relative alignment of the nut to the base plate.
3. Tighten top nuts following a crisscross pattern:
  - 3.1. Additional 1/6 turn for anchor bolts greater than 1-1/2 inches in diameter.
  - 3.2. Additional 1/3 turn for other anchor bolts.
  - 3.3. Tightening tolerance for all top nuts is  $\pm 1/8$  turn.

**Replace the 1st sentence of the 4th paragraph of section 56-3.01C(2)(b) with:**

07-15-16

If shown, use sleeve nuts on Type 1 standards.

**Add to section 56-3.01C(2)(b):**

07-15-16

Spiral reinforcement must be continuous above the bottom of the anchor bolts. The top termination must be either:

1. 1'-6" lap beyond the end of pitch with a 90-degree hook extending to the opposite side of the cage, or
2. 1'-6" lap beyond the end of pitch with 2 evenly spaced authorized mechanical couplers

**Replace the 1st sentence of the paragraph in section 56-3.02A(4)(b) with:**

07-15-16

For cast slip bases for standards and poles with shaft lengths of 15 feet or more, perform RT on 1 casting from each lot of a maximum of 50 castings under ASTM E94.

**Replace the 2nd paragraph of section 56-3.02B(1) with:**

07-15-16

Material for push button posts, pedestrian barricades, and guard posts must comply with ASTM A53/A53M or ASTM A500/A500M.

**Add to section 56-3.02B(1):**

07-15-16

Steel pipe standards and mast arms must be hot dip galvanized after manufacturing. Remove spikes from galvanized surfaces.

**Replace the 2nd paragraph of section 56-3.02B(2) with:**

07-15-16

HS anchor bolts, nuts, and washers must comply with section 55-1.02D(1) and the following:

1. Bolt threads must be rolled
2. Hardness of HS anchor bolts must not exceed 34 HRC when tested under ASTM F606
3. Galvanization must be by mechanical deposition
4. Nuts must be heavy-hex type
5. Each lot of nuts must be proof load tested

**Replace the 2nd sentence of the 9th paragraph of section 56-3.02B(2) with:**

07-15-16

During manufacturing, properly locate the position of the luminaire arm on the arm plate to avoid interference with the cap screw heads.

**Add to section 56-3.02B(3)(a):**

07-15-16

Steel having a nominal thickness greater than 2 inches that is used for tube-to-transverse plate connections must have a minimum CVN impact value of 20 ft-lb at 20 degrees F when tested under ASTM E23.

**Add to section 56-3.02B(3)(c):**

07-15-16

The length of telescopic slip-fit splices must be at least 1.5 times the inside diameter of the exposed end of the female section.

For welds connecting reinforced handholes or box-type pole plate connections to a tubular member, the start and stop points must be at points located on a longitudinal axis of symmetry of the tube coinciding with the axis of symmetry of the hand hole or pole plate.





### **64-3.02C Concrete Backfill**

Concrete for concrete backfill for slotted plastic pipe must comply with the specifications for minor concrete. You may use RSC instead of minor concrete for concrete backfill.

If RSC is used for concrete backfill, the RSC must:

1. Contain at least 590 pounds of cementitious material per cubic yard
2. Comply with section 90-3.02A, except section 90-1 does not apply
3. Comply with section 90-2

### **64-3.02D Heel-Resistant Grates**

Heel-resistant grate must:

1. Be designed to carry traffic loadings
2. Comply with ADA requirements
3. Be constructed of steel or cast iron
4. Be provided by the same manufacturer of the slotted plastic pipe
5. Comply with the manufacturer's instructions

### **64-3.02E Bar Reinforcement**

Bar reinforcement must comply with ASTM A615/A615M, Grade 60 or ASTM A706/A706M, Grade 60.

### **64-3.02F Miscellaneous Metal**

Ductile iron, nuts, bolts, and washers must comply with section 75.

### **64-3.02G Grout**

Grout must be non-shrink grout complying with ASTM C1107/C1107M.

### **64-3.02H Curing Compound**

Non-pigmented curing compound must comply with ASTM C309, Type 1, Class B.

### **64-3.02I End Caps**

End cap must:

1. Be provided by the same manufacturer of the slotted plastic pipe
2. Prevent concrete backfill from entering the pipe

## **64-3.03 CONSTRUCTION**

### **64-3.03A General**

Cover the grate slots with heavy-duty tape or other authorized covering during paving and concrete backfilling activities to prevent material from entering the slots.

### **64-3.03B Preparation**

Pave adjacent traffic lanes before installing slotted plastic pipes.

Excavation must comply with section 19-3.

### **64-3.03C Installation**

Lay and join slotted plastic pipes under the pipe manufacturer's instructions.

Lay pipes to line and grade with sections closely jointed and adequately secured to prevent separation during placement of the concrete backfill. If the pipes do not have a positive interlocking mechanism like a slot and tongue connection, secure the sections together with nuts, bolts, and washers before backfilling.

The top of slotted plastic pipes must not extend above the completed surface. Position the pipes so that the concrete backfill is flush with the surrounding grade and above the top of the grate from 1/8 to 1/4 inch.

Place channels with the male and female ends facing each other.



Replace the 2nd heading in section 71-5.03 with:

01-15-16

**71-5.03B Frames, Covers, Grates, and Manholes**

AA

**DIVISION VIII MISCELLANEOUS CONSTRUCTION  
72 SLOPE PROTECTION**

07-15-16

Replace the 1st and 2nd paragraphs of section 72-2.02B with:

07-15-16

For method A and B placement and the class of RSP described, comply with the rock gradation shown in the following table:

**Rock Gradation**

Nominal RSP class by median particle diameter <sup>b</sup>		Nominal median particle weight $W_{50}^{c,d}$	$d_{15}^c$ (inches)		$d_{50}^c$ (inches)		$d_{100}^c$ (inches)	Placement
Class <sup>a</sup>	Diameter (inches)		Min	Max	Min	Max	Max	Method
I	6	20 lb	3.7	5.2	5.7	6.9	12.0	B
II	9	60 lb	5.5	7.8	8.5	10.5	18.0	B
III	12	150 lb	7.3	10.5	11.5	14.0	24.0	B
IV	15	300 lb	9.2	13.0	14.5	17.5	30.0	B
V	18	1/4 ton	11.0	15.5	17.0	20.5	36.0	B
VI	21	3/8 ton	13.0	18.5	20.0	24.0	42.0	A or B
VII	24	1/2 ton	14.5	21.0	23.0	27.5	48.0	A or B
VIII	30	1 ton	18.5	26.0	28.5	34.5	48.0	A or B
IX	36	2 ton	22.0	31.5	34.0	41.5	52.8	A
X	42	3 ton	25.5	36.5	40.0	48.5	60.5	A
XI	46	4 ton	28.0	39.4	43.7	53.1	66.6	A

<sup>a</sup>For RSP Classes I–VIII, use Class 8 RSP fabric. For RSP Classes IX–XI, use Class 10 RSP fabric.

<sup>b</sup>Intermediate or B dimension (i.e., width) where A dimension is length and C dimension is thickness.

<sup>c</sup>d%, where % denotes the percentage of the total weight of the graded material.

<sup>d</sup>Values shown are based on the minimum and maximum particle diameters shown and an average specific gravity of 2.65. Weight will vary based on specific gravity of rock available for the project.

Replace the table in section 72-2.02C with:

07-15-16

**Fabric Class**

Class	Largest rock gradation class used in slope protection
8	Classes I–VIII
10	Classes IX–XI





## **80 FENCES**

07-15-16

**Replace section 80-4 with:**

07-15-16

### **80-4 WILDLIFE EXCLUSION FENCES**

#### **80-4.01 GENERAL**

##### **80-4.01A General**

Section 80-4 includes specifications for constructing wildlife exclusion fences.

Constructing a wildlife exclusion fence includes the installation of any signs specified in the special provisions.

##### **80-4.01B Materials**

Each T post must:

1. Comply with ASTM A702
2. Be metal and have an anchor plate
3. Be painted black or galvanized

##### **80-4.01C Construction**

Not Used

##### **80-4.01D Payment**

Not Used

#### **80-4.02 DESERT TORTOISE FENCES**

##### **80-4.02A General**

Section 80-4.02 includes specifications for constructing desert tortoise fences.

##### **80-4.02B Materials**

##### **80-4.02B(1) Permanent Desert Tortoise Fences**

##### **80-4.02B(1)(a) General**

Each wire tie and hog ring for a permanent desert tortoise fence must comply with section 80-2.02F.

Each hold down pin must:

1. Be U-shaped, with 2 minimum 6-inch long legs
2. Have pointed ends
3. Be at least 11-gauge wire
4. Be galvanized
5. Be commercial quality

##### **80-4.02B(1)(b) Hardware Cloth**

The hardware cloth must:

1. Comply with ASTM A740
2. Be welded or woven galvanized steel wire fabric
3. Be made of at least 14-gauge wire
4. Be 36 inches wide

##### **80-4.02B(1)(c) Barbless Wire**

The barbless wire must:

1. Comply with ASTM A641/A641M
2. Be at least 14-gauge wire
3. Have a Class 1 zinc coating

#### **80-4.02B(1)(d) Posts**

Each post must:

1. Comply with ASTM F1083
2. Be standard weight, schedule 40 steel pipe with a nominal pipe size of 1 inch
3. Be galvanized steel fence post conforming to ASTM A702

#### **80-4.02B(2) Temporary Desert Tortoise Fences**

The materials for a temporary desert tortoise fence must comply with section 80-4.02B(1), except the hardware cloth must be made of at least 16-gauge wire.

#### **80-4.02C Construction**

##### **80-4.02C(1) General**

Extend the hardware cloth a minimum of 24 inches above the ground.

Plumb the posts and pull the hardware cloth taut. Correct any alignment issues.

##### **80-4.02C(2) Permanent Desert Tortoise Fences**

Excavate the ground to form a trench before installing the posts and hardware cloth. Embed the posts at maximum 5-foot intervals into the ground. If T posts are used, use 5-foot lengths and embed the posts to match the above-ground height shown for the posts.

Securely fasten the hardware cloth to the posts with wire ties and to barbless wire with hog rings as shown. Pass the wire ties through the hardware cloth. Encircle the posts and barbless wire with the ties and tie them by twisting a minimum of 3 complete turns.

Bend the twisted ends of the ties down to prevent possible snagging. Close hog rings with their ends overlapping.

Bury the hardware cloth a minimum of 12 inches into the ground. Install the cloth in 1 continuous piece. You may cut the cloth into shorter segments if authorized.

Overlap the hardware cloth segments at posts, with a minimum overlap of 6 inches centered at a post. Wire tie the overlapped cloth to posts as shown. Prevent fraying by threading barbless wire along the vertical edges of the hardware cloth on either side of the post or use 3 equally spaced hog rings (6 hog rings per location) along each wire cloth edge.

Where bedrock or caliche substrate is encountered, use the bent hardware cloth detail if authorized. Transitions from buried-to-bent or bent-to-buried configuration must occur at a post location with a minimum 6-inch overlap of the hardware cloth as shown. The maximum spacing for hold down pins is 24 inches on center. Anchor in place with hold down pins the beginning and end corners of the hardware cloth placed on the ground.

Backfill the removed earth material into the trench created to install the hardware cloth and posts. Use an 8 lb or heavier hand tamper to compact the backfill around the posts and hardware cloth. Install a post at each corner of the cloth segments.

If a gate must be installed, attach the hardware cloth to the gate frame such that there is contact along the entire length of the gate between the finished ground surface and the lower edge of the cloth. Install the gate under section 80-10.

##### **80-4.02C(3) Temporary Desert Tortoise Fences**

Fold the horizontal edge of the hardware cloth at a 90° angle toward the tortoise habitat area. Ensure the clearance to the ground at the bend is from 0 to 2 inches.

Where the hardware cloth overlaps, secure the bend piece with one of the following:

1. Barbless wire threaded along the width of the cloth
2. Minimum of 4 hog rings equally spaced along the edge

Fasten the bent piece to the ground with hold down pins pushed completely into the ground.



**Add to the end of section 84-8.03A:**

07-15-16

The noise level created by the combined grinding activities must not exceed 86 dBA when measured at a distance of 50 feet at right angles to the direction of travel.

Break rumble strips before and after intersections, driveways, railroad crossings, freeway gore areas, and freeway ramps. Place breaks and break distances as shown. You may adjust breaks and the break distances as needed at low-volume driveways or other locations if authorized.

**Delete *new* in the 1st paragraph of section 84-8.03B.**

07-15-16

**Add to the end of section 84-8.03B:**

07-15-16

Remove grinding residue under section 13-4.03E(7).

**Replace the 1st paragraph of section 84-8.03C with:**

07-15-16

Construct rumble strips in the top layer of HMA and asphalt concrete surfacing by the ground-in method.

**Add between the 2nd and 3rd paragraphs of section 84-8.03C:**

07-15-16

Dispose of the removed material.

**Delete the 2nd paragraph of section 84-8.03C.**

07-15-16

**Replace 37-2 in the 3rd paragraph of section 84-8.03C with:**

07-15-16

37-4.02

**Replace section 84-8.04 with:**

07-15-16

The payment quantity for any type of rumble strip is the length measured by the station along the length of the rumble strip without deductions for gaps between indentations.

**Replace the 2nd paragraph of section 84-9.03B with:**

04-15-16

Completely remove traffic stripes and pavement markings, including any paint in the gaps, by methods that do not remove pavement to a depth of more than 1/8 inch.

**Add between the 2nd and 3rd paragraphs of section 84-9.03B:**

04-15-16

Submit your proposed method for removing traffic stripes and pavement markings at least 7 days before starting the removal work. Allow 2 business days for the review.

Remove pavement marking such that the old message cannot be identified. Make any area removed by grinding rectangular. Water must not puddle in the ground areas. Fog seal ground areas on asphalt concrete pavement.

Delete *materially* in the 1st paragraph of section 84-9.03D.

AA

## DIVISION X ELECTRICAL WORK

Replace section 86 with:

### 86 GENERAL

04-15-16

#### 86-1.01 GENERAL

##### 86-1.01A Summary

Section 86 includes general specifications for furnishing electrical equipment and materials.

Electrical equipment and materials must comply with part 4 of the *California MUTCD* and 8 CA Code of Regs, chapter 4, subchapter 5, "Electrical Safety Orders."

Galvanized equipment and materials must comply with section 75-1.02B.

##### 86-1.01B Definitions

**accessible pedestrian signal:** Accessible pedestrian signal as defined in the *California MUTCD*.

**accessible walk indication:** Activated audible and vibrotactile action during the walk interval.

**actuation:** Actuation as defined in the *California MUTCD*.

**ambient sound level:** Background sound level in dB at a given location.

**ambient sound sensing microphone:** Microphone that measures the ambient sound level in dB and automatically adjusts the accessible pedestrian signal speaker's volume.

**audible speech walk message:** Audible prerecorded message that communicates to pedestrians which street has the walk interval.

**channel:** Discrete information path.

**CALiPER:** Commercially Available LED Product Evaluation and Reporting. A U.S. Department of Energy program that individually tests and provides unbiased information on the performance of commercially available LED luminaires and lights.

**controller assembly:** Assembly for controlling a system's operations, consisting of a controller unit and auxiliary equipment housed in a waterproof cabinet.

**controller unit:** Part of the controller assembly performing the basic timing and logic functions.

**correlated color temperature:** Absolute temperature in kelvin of a blackbody whose chromaticity most nearly resembles that of the light source.

**detector:** Detector as defined in the *California MUTCD*.

**electrolier:** Assembly of a lighting standard and luminaire.

**flasher:** Device for opening and closing signal circuits at a repetitive rate.

**flashing beacon control assembly:** Assembly of switches, circuit breakers, terminal blocks, flasher, wiring, and other necessary electrical components housed in a single enclosure for operating a beacon.

**house side lumens:** Lumens from a luminaire directed to light up areas between the fixture and the pole, such as sidewalks at intersection or areas off the shoulders on freeways.

**illuminance gradient:** Ratio of the minimum illuminance on a 1-foot square of sign panel to that on an adjacent 1-foot square of sign panel.

**inductive loop detector:** Detector capable of being actuated by an inductance change caused by a vehicle passing or standing over the loop. An inductive loop detector includes a loop or group of loops installed in the roadway and a lead-in cable installed and connected inside a controller cabinet.

**junction temperature:** Temperature of the electronic junction of the LED device. The junction temperature is critical in determining photometric performance, estimating operational life, and preventing catastrophic failure of the LED.

**L70:** Extrapolated life in hours of the luminaire when the luminous output depreciates 30 percent from the initial values.

**lighting standard:** Pole and mast arm supporting the luminaire.

**LM-79:** Test method from the Illumination Engineering Society of North America specifying the test conditions, measurements, and report format for testing solid state lighting devices, including LED luminaires.

**LM-80:** Test method from the Illumination Engineering Society of North America specifying the test conditions, measurements, and report format for testing and estimating the long-term performance of LEDs for general lighting purposes.

**luminaire:** Assembly that houses the light source and controls the light emitted from the light source.

**National Voluntary Laboratory Accreditation Program:** U.S. Department of Energy program that accredits independent testing laboratories.

**powder coating:** Coating applied electrostatically using exterior-grade, UV-stable, polymer powder.

**power factor:** Ratio of the real power component to the complex power component.

**pretimed controller assembly:** Assembly operating traffic signals under a predetermined cycle length.

**programming mechanism:** Device to program the accessible pedestrian signal operation.

**pull box:** Box with a cover that is installed in an accessible place in a conduit run to facilitate the pulling in of wires or cables.

**push button information message:** Push button information message as defined in the *California MUTCD*.

**push button locator tone:** Push button locator tone as defined in the *California MUTCD*.

**signal face:** Signal face as defined in the *California MUTCD*.

**signal head:** Signal head as defined in the *California MUTCD*.

**signal indication:** Signal indication as defined in the *California MUTCD*.

**signal section:** Signal section as defined in the *California MUTCD*.

**signal standard:** Pole with or without mast arms carrying 1 or more signal faces.

**street side lumens:** Lumens from a luminaire directed to light up areas between the fixture and the roadway, such as traveled ways and freeway lanes.

**surge protection device:** Subsystem or component that protects equipment against short-duration voltage transients in power line.

**total harmonic distortion:** Ratio of the rms value of the sum of the squared individual harmonic amplitudes to the rms value of the fundamental frequency of a complex waveform.

**traffic-actuated controller assembly:** Assembly for operating traffic signals under the varying demands of traffic as registered by detector actuation.

**traffic phase:** Traffic phase as defined in the *California MUTCD*.

**vehicle:** Vehicle as defined in the *California Vehicle Code*.

**vibrotactile pedestrian device:** Vibrotactile pedestrian device as defined in the *California MUTCD*.

### **86-1.01C Submittals**

#### **86-1.01C(1) General**

Within 15 days after Contract approval, submit a list of equipment and materials you propose to install.

Submit the list before shipping equipment and materials to the job site. The list must include:

1. Manufacturer's name
2. Make and model number
3. Month and year of manufacture
4. Lot and serial numbers
5. Contract number
6. Your contact information

Submit confirmation of the vendor's acceptance of the order for the electrical equipment and materials as an informational submittal.

Submit 3 sets of computer-generated, schematic wiring diagrams for each cabinet.

Diagrams, plans, and drawings must be prepared using graphic symbols in IEEE 315, "Graphic Symbols for Electrical and Electronic Diagrams."

Submit a schedule of values within 15 days after Contract approval.

Do not include costs for the traffic control system in the schedule of values.

Submit a manufacturer's maintenance manual or combined maintenance and operation manual as an informational submittal. The manual must have a master item index that includes:

1. Specifications
2. Design characteristics
3. General operation theory
4. Function of all controls
5. Troubleshooting procedure
6. Parts list, descriptions, stock numbers, and settings
7. Block circuit diagram
8. Layout of components
9. Schematic diagrams

#### **86-1.01C(2) Pull Boxes**

Submit the manufacturer's installation instructions for pull boxes, including:

1. Quantity and size of entries that can be made without degrading the strength of the pull box below the load rating
2. Locations where side entries can be made
3. Acceptable method for creating the entry

Submit load-rating test reports for pull boxes from a NRTL.

#### **86-1.01C(3) LED Luminaires**

Submit for an LED luminaire:

1. Maximum power in watts
2. Maximum designed junction temperature
3. Heat sink area in square inches



4. Designed junction-to-ambient thermal resistance calculation with thermal resistance components clearly defined
5. L70 in hours when extrapolated for the average nighttime operating temperature
6. Life expectancy based on the junction temperature
7. Manufacturer's data sheet for the power supply, including the rated life

Submit the manufacturer's QC test data for LED luminaires as an informational submittal.

#### **86-1.01C(4) Low-Pressure Sodium Luminaires**

Submit the manufacturer's QC test data for low-pressure sodium luminaires as an informational submittal.

#### **86-1.01C(5) Service Equipment Enclosures**

Submit shop drawings for a service equipment enclosure to METS.

#### **86-1.01C(6) Signal Heads**

Submit a certificate of compliance and the manufacturer's QC test data for signal heads as an informational submittal.

#### **86-1.01C(7) LED Signal Modules**

Submit the manufacturer's QC test data for LED signal modules as an informational submittal.

#### **86-1.01C(8) Visors**

Submit a certificate of compliance and the manufacturer's QC test data for visors as an informational submittal.

#### **86-1.01C(9) LED Countdown Pedestrian Signal Face Modules**

Submit the manufacturer's QC test data for LED countdown pedestrian signal face modules as an informational submittal.

#### **86-1.01C(10) Accessible Pedestrian Signals**

Submit the manufacturer's QC test data for accessible pedestrian signals as an informational submittal.

#### **86-1.01D Quality Assurance**

##### **86-1.01D(1) General**

Electrical equipment must comply with one or more of the following standards:

1. ANSI
2. ASTM
3. EIA/ECIA
4. NEMA
5. NETA
6. UL/NRTL
7. TIA

Materials must comply with:

1. FCC rules
2. ITE standards
3. NEC
4. California Electrical Code

##### **86-1.01D(2) Source Quality Control**

Service equipment enclosures and cabinets must be inspected and tested at the source.

##### **86-1.01D(3) Department Acceptance**

Deliver material and equipment for testing to METS.

Allow 30 days for testing. The Department notifies you when testing is complete.

If the Department accepts the material or equipment, you must pick it up from the test site and deliver it to the job site.

If the Department rejects material or equipment, remove it within 5 business days after you are notified it is rejected. If it is not removed within that period, the Department may remove it and ship it to you and deduct the costs of labor, material and shipping.

Resubmit a new sample and allow 30 days for retesting. The retesting period starts when the replacement material or equipment is delivered to METS.

## **86-1.02 MATERIALS**

### **86-1.02A General**

Anchor bolts, anchor bars or studs, and nuts and washers must comply with section 75-1.02.

Bolt threads must accept galvanized standard nuts without requiring tools or causing removal of protective coatings.

### **86-1.02B Conduit and Accessories**

#### **86-1.02B(1) General**

Conduit and fittings must comply with the requirements shown in the following table:

<b>Conduit and Fitting Requirements</b>	
Type	Requirement
1	Must be hot-dip galvanized rigid steel complying with UL 6 and ANSI C80.1. The zinc coating must comply with copper sulfate test requirements in UL 6. Fittings must be electrogalvanized and certified under UL 514B.
2	Must comply with requirements for Type 1 conduit and be coated with PVC or polyethylene. The exterior thermoplastic coating must have a minimum thickness of 35 mils. The internal coating must have a minimum thickness of 2 mils. Coated conduit must comply with NEMA RN 1, or NRTL PVC-001.
3	Must be Type A, extruded, rigid PVC conduit complying with UL 651 or must be HDPE conduit complying with UL 651A.
4	Must have an inner, flexible metal core covered by a waterproof, nonmetallic, sunlight-resistant jacket, and must be UL listed for use as a grounding conductor. Fittings must be certified under UL 514B.
5	Must be intermediate steel complying with UL 1242 and ANSI C80.6. The zinc coating must comply with copper sulfate test requirements specified in UL 1242. Fittings must be electrogalvanized and certified under UL 514B.

Bonding bushings installed on metal conduit must be insulated and either a galvanized or zinc-alloy type.

#### **86-1.02B(2) Structures Accessories**

Steel hangers, steel brackets, and other fittings used to support conduit in or on a wall or bridge superstructure must comply with section 75-3.

Precast concrete cradles for conduit must be made of minor concrete and commercial-quality welded wire fabric. The minor concrete must contain a minimum of 590 lb of cementitious material per cubic yard. The cradles must be moist cured for a minimum of 3 days.

### **86-1.02C Pull Boxes**

#### **86-1.02C(1) General**

Pull box cover must have a marking on the top that is:

1. Clearly defined
2. Uniform in depth
3. Parallel to either side
4. 1 to 3 inches in height

Cover marking must be:

1. *SERVICE* for service circuits between a service point and service disconnect
2. *SERVICE IRRIGATION* for circuits from a service equipment enclosure to an irrigation controller
3. *SERVICE BOOSTER PUMP* for circuits from a service equipment enclosure to the booster pump
4. *TDC POWER* for circuits from a service equipment enclosure to telephone demarcation cabinet
5. *LIGHTING* for a lighting system
6. *SIGN ILLUMINATION* for a sign illumination system
7. *SIGNAL AND LIGHTING* for a signal and lighting system
8. *RAMP METER* for a ramp metering system
9. *TMS* for a traffic monitoring station
10. *FLASHING BEACON* for a flashing beacon system
11. *CMS* for a changeable message sign system
12. *INTERCONNECT* for an interconnect conduit and cable system

The load rating must be stenciled on the inside and outside of the pull box and the cover.

If a transformer or other device must be placed in the pull box, include recesses for a hanger.

The hardware must be stainless steel with 18 percent chromium and 8 percent nickel content.

#### **86-1.02C(2) Nontraffic Pull Boxes**

A nontraffic pull box and cover must comply with ANSI/SCTE 77, "Specification for Underground Enclosure Integrity," for Tier 22 load rating and must be gray or brown.

Each new pull box must have a cover with an electronic marker cast inside.

A pull box extension must be made of the same material as the pull box. The extension may be another pull box if the bottom edge of the pull box fits into the opening for the cover.

The bolts, nuts, and washers must be a captive design and galvanized. Captive bolts for securing the cover of nontraffic pull boxes must be capable of withstanding a torque from 55 to 60 ft-lb and a minimum pull-out strength of 750 lb.

#### **86-1.02C(3) Traffic Pull Boxes**

A traffic pull box and cover must comply with ASTM C857 for HS20-44 loading.

The frame must be anchored to the box with 2-1/4-inch-long concrete anchors with a 1/4 inch diameter. A no. 3-1/2(T) pull box must have 4 concrete anchors, one placed in each corner. No. 5(T) and no. 6(T) pull boxes must have 6 concrete anchors, one placed in each corner and one near the middle of each of the longer sides.

Nuts must be vibration-resistant, zinc-plated, carbon steel and have a wedge ramp at the root of the thread.

Before galvanizing a steel or cast iron cover, the manufacturer must apply the cover marking by one of the following methods:

1. Use a cast iron strip at least 1/4 inch thick with letters raised a minimum of 1/16 inch. Fasten the strip to the cover with 1/4-inch, flathead, stainless steel machine bolts and nuts. Peen the bolts after tightening.
2. Use a sheet steel strip at least 0.027 inch thick with letters raised a minimum of 1/16 inch. Fasten the strip to the cover by spot welding, tack welding, or brazing with 1/4-inch stainless steel rivets or 1/4-inch, roundhead, stainless steel machine bolts and nuts. Peen the bolts after tightening.

The steel cover must be countersunk approximately 1/4 inch to accommodate the bolt head. When tightened, the bolt head must be no more than 1/8 inch above the top of the cover.

#### **86-1.02C(4) Reserved**

#### **86-1.02D Tapes**

#### **86-1.02D(1) General**

Reserved

**86-1.02D(2) Pull Tape**

Pull tape must be a flat, woven, lubricated, soft-fiber, polyester tape with a minimum tensile strength of 1,800 lb. The tape must have sequential measurement markings every 3 feet.

**86-1.02D(3) Reserved**

**86-1.02E Reserved**

**86-1.02F Conductors and Cables**

**86-1.02F(1) Conductors**

**86-1.02F(1)(a) General**

Reserved

**86-1.02F(1)(b) Reserved**

**86-1.02F(1)(c) Copper Conductors**

**86-1.02F(1)(c)(i) General**

Copper wire must comply with ASTM B3 and B8.

Conductor must be clearly and permanently marked the entire length of its outer surface with:

1. Manufacturer's name or trademark
2. Insulation-type letter designation
3. Conductor size
4. Voltage
5. Temperature rating
6. Number of conductors for a cable

The minimum insulation thickness and color code requirements must comply with NEC.

A conductor must be UL listed or NRTL certified and rated for 600 V(ac).

Insulation for no. 14 to no. 4 conductors must be one of the following:

1. Type TW PVC under ASTM D2219
2. Type THW PVC
3. Type USE, RHH, or RHW cross-linked polyethylene

The insulation for no. 2 and larger conductors must be one of the above or THWN.

Conductors must be identified as shown in the following table:

### Conductor Identification

Circuit	Signal phase or function	Identification			Size
		Insulation color <sup>d</sup>		Band symbols	
		Base	Stripe <sup>a</sup>		
Signals (vehicle) <sup>a, b</sup>	2, 6	Red, yel, brn	Blk	2, 6	14
	4, 8	Red, yel, brn	Ora	4, 8	14
	1, 5	Red, yel, brn	None	1, 5	14
	3, 7	Red, yel, brn	Pur	3, 7	14
	Ramp meter 1	Red, yel, brn	None	NBR	14
	Ramp meter 2	Red, yel, brn	Blk	NBR	14
Pedestrian signals	2p, 6p	Red, brn	Blk	2p, 6p	14
	4p, 8p	Red, brn	Ora	4p, 8p	14
	1p, 5p	Red, brn	None	1p, 5p	14
	3p, 7p	Red, brn	Pur	3p, 7p	14
Pedestrian push buttons	2p, 6p	Blu	Blk	P-2, P-6	14
	4p, 8p	Blu	Ora	P-4, P-8	14
	1p, 5p	Blu	None	P-1, P-5	14
	3p, 7p	Blu	Pur	P-3, P-7	14
Traffic signal controller cabinet	Ungrounded circuit conductor	Blk	None	CON-1	6
	Grounded circuit conductor	Wht	None	CON-2	6
Highway lighting pull box to luminaire	Ungrounded - line 1	Blk	None	NBR	14
	Ungrounded - line 2	Red	None	NBR	14
	Grounded	Wht	None	NBR	14
Multiple highway lighting	Ungrounded - line 1	Blk	None	ML1	10
	Ungrounded - line 2	Red	None	ML2	10
Lighting control	Ungrounded - PEU	Blk	None	C1	14
	Switching leg from PEU unit or SM transformer	Red	None	C2	14
Service	Ungrounded - line 1 (signals)	Blk	None	NBR	6
	Ungrounded - line 2 (lighting)	Red	None	NBR	8
Sign lighting	Ungrounded - line 1	Blk	None	SL-1	10
	Ungrounded - line 2	Red	None	SL-2	10
Flashing beacons	Ungrounded between flasher and beacons	Red or yel	None	F-Loc. <sup>c</sup>	14
Grounded circuit conductor	Pedestrian push buttons	Wht	Blk	NBR	14
	Signals and multiple lighting	Wht	None	NBR	10
	Flashing beacons and sign lighting	Wht	None	NBR	12
	Lighting control	Wht	None	C-3	14
	Service	Wht	None	NBR	14
Railroad preemption		Blk	None	R	14
Spares		Blk	None	NBR	14

NBR = No band required      PEU=Photoelectric unit

<sup>a</sup>On overlaps, the insulation is striped for the 1st phase in the designation, e.g., phase (2+3) conductor is striped as for phase 2.

<sup>b</sup>Band for overlap and special phases as required

<sup>c</sup>Flashing beacons having separate service do not require banding.

<sup>d</sup>Color Code: Yel-Yellow, Brn-Brown, Blu-Blue, Blk-Black, Wht-White, Ora-Orange, Pur-Purple

The insulation color must be homogeneous throughout the full depth of the insulation. The identification stripe must be continuous throughout the length of the conductor.

**86-1.02F(1)(c)(ii) Bonding Jumpers and Equipment Grounding Conductors**

A bonding jumper must be copper wire or copper braid of the same cross-sectional area as a no. 8 conductor or larger.

An equipment grounding conductor may be bare or insulated.

**86-1.02F(1)(c)(iii) Inductive Loop Conductors**

Inductive loop conductor must comply with the requirements shown in the following table:

**Conductor Requirements for Inductive Loop Detectors**

Loop wire	Requirement
Type 1	Type RHW-USE neoprene-jacketed or Type USE cross-linked polyethylene, insulated, no. 12, stranded copper wire with a minimum 40-mils insulation thickness at any point.
Type 2	Type THWN or Type XHHW, no. 14, stranded copper wire in a plastic tubing. The plastic tubing must be polyethylene or vinyl rated for use at 105 °C and resistant to oil and gasoline. The outside diameter of the tubing must be at most 0.27 inch with a wall thickness of at least 0.028 inch.

**86-1.02F(1)(d) Reserved**

Reserved

**86-1.02F(2) Cables**

**86-1.02F(2)(a) General**

Reserved

**86-1.02F(2)(b) Reserved**

Reserved

**86-1.02F(2)(c) Reserved**

**86-1.02F(2)(d) Copper Cables**

**86-1.02F(2)(d)(i) General**

The conductor wire size for a detector lead-in cable must comply with the requirements of ASTM B286.

Cable, except a detector lead-in cable, must be clearly and permanently marked the entire length of its outer surface with:

1. Manufacturer's name or trademark
2. Insulation-type letter designation
3. Conductor size
4. Voltage
5. Temperature rating
6. Number of conductors for a cable

**86-1.02F(2)(d)(ii) Conductors Signal Cables**

A conductors signal cable must have a black polyethylene jacket with an inner polyester binder sheath. The cable jacket must be rated for 600 V(ac) and 75 degrees C. Filler material, if used, must be polyethylene.

The individual conductors in the cable must be solid copper complying with ASTM B286 with Type THWN insulation. The minimum thickness of insulation must comply with NEC for conductor sizes no. 14 to no.10. The minimum thickness of the nylon jacket must be 4 mils.

Cable must comply with the requirements shown in the following table:

Cable type <sup>a</sup>	Conductor quantity and type	Cable jacket thickness (mils)		Maximum nominal outside diameter (inch)	Conductor color code
		Average	Minimum		
3CSC	3 no. 14	44	36	0.40	Blue/black, blue/orange, white/black stripe
5CSC	5 no. 14	44	36	0.50	Red, yellow, brown, black, white
9CSC	8 no. 14 1 no. 12	60	48	0.65	No. 12 - white, no. 14 - red, yellow, brown, black, and red/black, yellow/black, brown/black, white/black stripe
12CSC	11 no. 14 1 no. 12	60	48	0.80	No. 12 - white, no. 14 - red, yellow, brown, red/black stripe, yellow/black stripe, brown/black stripe, black/red stripe, black/white stripe, black, red/white stripe, brown/white stripe
28CSC	27 no. 14 1 no. 10	80	64	0.90	No. 10 - white no. 14 - red/black stripe, yellow/black stripe, brown/black stripe, red/orange stripe, yellow/orange stripe, brown/orange stripe, red/silver stripe, yellow/silver stripe, brown/silver stripe, red/purple stripe, yellow/purple stripe, brown/purple stripe, red/2 black stripes, brown/2 black stripes, red/2 orange stripes, brown/2 orange stripes, red/2 silver stripes, brown/2 silver stripes, red/2 purple stripes, brown/2 purple stripes, blue/black stripe, blue/orange stripe, blue/silver stripe, blue/purple stripe, white/black stripe, black/red stripe, black

**86-1.02F(2)(d)(iii) Detector Lead-in Cables**

Conductors for a loop detector lead-in cable must be two no. 16, 19-by-29, stranded, tinned copper wires with calculated cross-sectional areas complying with ASTM B286, table 1 and must comply with the requirements shown in the following table:

### Conductor Requirements for Loop Detector Lead-In Cables

Lead-in cable	Requirement
Type B	Insulated with 20 mils of high-density polyethylene. Conductors must be twisted together with at least 2 turns per foot, and the twisted pair must be protected with a copper or aluminum polyester shield. A minimum no. 20 copper drain wire must be connected to the equipment ground within the cabinet. Cable must have a high-density polyethylene or high-density polypropylene outer jacket with a nominal thickness of 32 mils. Include an amorphous, interior, moisture penetration barrier of nonhydroscopic polyethylene or polypropylene fillers.
Type C	Comply with International Municipal Signal Association Specification no. 50-2. A minimum no. 20 copper drain wire must be connected to the equipment ground within the cabinet.

**86-1.02F(2)(d)(iv) Reserved**

**86-1.02F(2)(d)(v) Signal Interconnect Cables**

A signal interconnect cable must be a 6-pair type with stranded, tinned, copper no. 20 conductors. The insulation for each conductor must be color-coded polypropylene with a minimum 13-mils nominal thickness. The conductors must be in color-coded, twisted pairs. Each pair must be wrapped with an aluminum polyester shield and have a no. 22 or larger, stranded, tinned, copper drain wire inside the shielded pair.

The cable jacket must be black HDPE rated for a minimum of 300 V(ac) and 60 degrees C. The jacket must have a minimum nominal wall thickness of 40 mils.

**86-1.02F(2)(e) Reserved**

**86-1.02G Equipment Identification Characters**

Equipment identification characters must be 2-1/2 inch, series D lettering, except on wood poles, they must be 3-inch lettering.

The characters must be self-adhesive reflective labels or paint, except on wood poles, they must be embossed on aluminum.

**86-1.02H Splicing Materials**

Splicing materials include:

1. Connectors
2. Electrical insulating coating
3. PVC electrical tape
4. Butyl rubber stretchable tape
5. PVC pressure-sensitive adhesive tape
6. Heat shrink tubing

Connectors must be C-shaped compression or butt type.

Electrical insulating coating must be a fast drying sealant with low nontoxic fumes.

PVC electrical tape must have a minimum thickness of 80 mils.

Butyl rubber stretchable tape with liner must have a minimum thickness of 120 mils.

PVC pressure-sensitive adhesive electrical tape must have a minimum thickness of 6 mils.

Electrical tapes must be self-fusing, oil- and flame-resistant, synthetic rubber and be UL listed or NRTL certified.

Heat-shrink tubing must be made of irradiated polyolefin tubing with a minimum wall thickness of 40 mils before contraction and an adhesive mastic inner wall. When heated, the inner wall must melt and fill the crevices and interstices of the covered splice area and the outer wall must shrink to form a waterproof insulation.



Heat-shrink tubing must comply with the requirements for extruded, insulating tubing at 600 V(ac) specified in UL Standard 468D and ANSI C119.1 and the requirements shown in the following table:

**Heat-Shrink Tubing Requirements**

Quality characteristic	Requirement
Shrinkage ratio of supplied diameter <sup>a</sup> (max, %)	33
Dielectric strength (min, kV/in)	350
Resistivity (min, Ω/in)	25 x 10 <sup>13</sup>
Tensile strength (min, psi)	2,000
Operating temperature (°C)	-40–90 (135 °C in emergency)
Water absorption (max, %)	0.5

<sup>a</sup>When heated to 125 °C and allowed to cool to 25 °C

**86-1.02I Connectors and Terminals**

A connector and terminal must comply with SAE-AS7928 and be a crimp type, rated for 600 V(ac) and either UL listed or NRTL certified.

**86-1.02J Standards, Poles, Pedestals, and Posts**

Standards for signals, lighting, and flashing beacons, poles for closed circuit television, pedestals for cabinets, posts for extinguishable message sign and posts for pedestrian push button assemblies must comply with section 56-3.

**86-1.02K Luminaires**

**86-1.02K(1) General**

Luminaire must be either LED or low-pressure-sodium type.

**86-1.02K(2) LED Luminaires**

LED luminaire must be on the Authorized Material List for LED luminaires and must:

1. Be self-contained, not requiring assembly.
2. Comply with UL 1598 for luminaires in wet locations.
3. Have a power supply with:
  - 3.1. ANSI/IEC rating of at least IP65.
  - 3.2. 2 leads to accept standard 0-10 V(dc).
  - 3.3. Dimming control compatible with IEC 60929, Annex E. If the control leads are open or the analog control signal is lost, the circuit must default to 100-percent power.
  - 3.4. Case temperature self rise of 77 degrees F or less above ambient temperature in free air with no additional heat sinks.
4. Weigh no more than 35 lb.
5. Have a minimum operating life of 63,000 hours when operated for an average time of 11.5 hours at an average temperature of 70 degrees F.
6. Be designed to operate over a temperature range from -40 to 130 degrees F.
7. Be operationally compatible with photoelectric controls.
8. Have a correlated color temperature range from 3,500 to 6,500 K and a color rendering index of 65 or greater.
9. Have a maximum-effective projected area of 1.4 sq ft when viewed from either side or end.
10. Have a housing color that matches a color no. 26152 to 26440, 36231 to 36375, or 36440 of FED-STD-595.
11. Have an ANSI C136.41-compliant, locking-type, photocontrol receptacle with dimming connections and a watertight shorting cap.
12. Comply with LM-79, LM-80 and California Test 611.

The individual LEDs must be connected such that a catastrophic loss or a failure of 1 LED does not result in the loss of more than 20 percent of the luminous output of the luminaire.

The luminaire must be permanently marked inside the unit and outside of its packaging box. Marking consists of:

1. Manufacturer's name or trademark

2. Month and year of manufacture
3. Model, serial, and lot numbers
4. Rated voltage, wattage, and power in VA

An LED luminaire's onboard circuitry must include a surge protection device to withstand high-repetition noise transients caused by utility line switching, nearby lightning strikes, and other interferences. The device must protect the luminaire from damage and failure due to transient voltages and currents as defined in Tables 1 and 4 of ANSI/IEEE C64.41.2 for location category C-High. The surge protection device must comply with UL 1449 and ANSI/IEEE C62.45 based on ANSI/IEEE C62.41.2 definitions for standard and optional waveforms for location category C-High.

An LED luminaire and its associated onboard circuitry must comply with the Class A emission limits under 47 CFR 15(B) for the emission of electronic noise.

The fluctuations of line voltage must have no visible effect on the luminous output.

The operating voltage may range from 120 to 480 V(ac), 60 ± 3 Hz. Luminaire must operate over the entire voltage range or the voltage range must be selected from one of the following:

1. Luminaire must operate over a voltage range from 95 to 277 V(ac). The operating voltages for this option are 120 V(ac) and 240 V(ac).
2. Luminaire must operate over a voltage range from 347 to 480 V(ac). The operating voltage for this option is 480 V(ac).

LED luminaire must have a power factor of 0.90 or greater. The total harmonic distortion, current, and voltage induced into a power line by a luminaire must not exceed 20 percent. The L70 of the luminaire must be the minimum operating life or greater. Illuminance measurements must be calibrated to standard photopic calibrations.

The maximum power consumption and maintained illuminance of the LED luminaires must comply with the isofootcandle curves as shown.

LED luminaire must not allow more than 10 percent of the rated lumens to project above 80 degrees from vertical and 2.5 percent of the rated lumens to project above 90 degrees from vertical.

Luminaire must have passive thermal management with enough capacity to ensure proper heat dissipation and functioning of the luminaire over its minimum operating life. The maximum junction temperature for the minimum operating life must not exceed 221 degrees F.

The junction-to-ambient thermal resistance must be 95 degrees F per watt or less. The use of fans or other mechanical devices is not allowed for cooling the luminaire. The heat sink must be made of aluminum or other material of equal or lower thermal resistance. The luminaire must contain circuitry that automatically reduces the power to the LEDs so the maximum junction temperature is not exceeded when the ambient temperature is 100 degrees F or greater.

The luminaire's housing must be fabricated from materials designed to withstand a 3,000-hour salt spray test under ASTM B117. All aluminum used in housings and brackets must be made of a marine-grade alloy with less than 0.2 percent copper. All exposed aluminum must be anodized. A chromate conversion undercoating must be used underneath a thermoplastic polyester powder coat.

The housing must be designed to prevent the buildup of water on its top surface. Exposed heat sink fins must be oriented to allow water to run off the luminaire and carry dust and other accumulated debris away from the unit. The optical assembly of the luminaire must be protected against dust and moisture intrusion to at least an UL 60529 rating of IP66. The power supply enclosure must be protected to at least an UL 60529 rating of IP43.

The housing must have a slip fitter capable of being mounted on a 2-inch-diameter pipe tenon. Slip fitter must:

1. Fit on mast arms with outside diameters from 1-5/8 to 2-3/8 inches
2. Be adjustable to a minimum of ±5 degrees from the axis of the tenon in a minimum of 5 steps: +5, +2.5, 0, -2.5, -5
3. Have clamping brackets that:

- 3.1. Are made of corrosion-resistant materials or treated to prevent galvanic reactions
- 3.2. Do not bottom out on the housing bosses when adjusted within the designed angular range
- 3.3. Do not permanently set in excess of 1/32 inch when tightened

Each refractor or lens must be made of UV-inhibiting high-impact plastic, such as acrylic or polycarbonate, or heat- and impact-resistant glass. The refractor or lens must be resistant to scratching. Polymeric materials, except for the lenses of enclosures containing either the power supply or electronic components of the luminaire, must be made of UL94 V-0 flame-retardant materials.

An LED luminaire and its internal components must be able to withstand mechanical shock and vibration.

If the components are mounted on a down-opening door, the door must be hinged and secured to the luminaire's housing separately from the refractor or flat lens frame. The door must be secured to the housing to prevent accidental opening. A safety cable must mechanically connect the door to the housing.

An LED luminaire must have a barrier-type terminal block secured to the housing to connect field wires. The terminal screws must be captive and equipped with wire grips for conductors up to no. 6.

The conductors and terminals must be identified and marked.

### **86-1.02K(3) Low-Pressure Sodium luminaires**

A low-pressure sodium luminaire must be an enclosed cutoff or semi-cutoff type and be self-contained, not requiring assembly.

The housing must be either (1) a minimum 1/16-inch-thick, corrosion-resistant, die-cast aluminum sheet and plate with concealed continuous welds or (2) a minimum 3/32-inch-thick, acrylonitrile-butadiene-styrene sheet material on a cast aluminum frame. The housing must provide mounting for all electrical components and a slip fitter. The housing must be divided into optical and power compartments that are individually accessible for service and maintenance.

The painted exterior surface of the luminaire must be finished with a fused coating of electrostatically applied polyester powder paint or other UV-inhibiting film. The color must be aluminum gray.

A sealing ring must be installed in the pipe tenon opening to prevent the entry of water and insects into the power and optical compartments. The ring must be made of high-temperature neoprene or equal material.

The power unit assembly must be accessible through a weather-tight, hinged cover secured to the housing with spring latches or captive screws.

The luminaire's hardware must be stainless steel or cadmium plated. Removable components must be secured with machine screws or bolts instead of sheet metal screws.

A semi-cutoff luminaire or a molded refractor-style cutoff luminaire must include a refractor. Other cutoff luminaires must include a flat lens. The refractor assembly and flat lens assembly must be designed to rigidly maintain their shape and be hinged and secured to the housing with spring latches.

The refractor must be either a 1-piece injection-molded polycarbonate with a minimum thickness of 3/32 inch or a 1-piece injection-molded acrylic with a minimum thickness of 1/8 inch. Alternate methods of manufacturing the refractor may be authorized provided minimum specified thicknesses are maintained.

The flat lens must be a 1-piece polycarbonate with a minimum thickness of 3/32 inch, mounted to a metal frame.

The lamp socket must be made of high-temperature, flame-retardant, thermoset material with self-wiping contacts or an equal. The socket must be rated for 660 W and 1,000 V(ac). The position of the socket and support must maintain the lamp in the correct relationship with the reflector and refractor for the designed light distribution pattern. The reflector may be an integral part of the housing.

The luminaire must comply with the isofotcandle curves as shown.

Low-pressure sodium lamp must:

1. Be a 180 W, single-ended, bayonet-base, tubular, gas-discharge lamp

2. Maintain a minimum of 93 percent of its initial lumens over its rated life
3. Reach 80 percent of its light output within 10 minutes
4. Restrike within 1 minute after a power outage or voltage drop at the lamp socket
5. Have ANSI L74/E designation

The lamp operating position must be at  $\pm 20$  degrees from the horizontal.

Lamp must comply with the minimum performance requirements shown in the following table:

<b>Minimum Performance Requirements</b>	
Quality characteristic	Requirement
Initial lumens (lm)	33,000
Rated average life at 10 h/start (h)	18,000

The low-pressure sodium lamp ballast must be an autotransformer or high-reactance type. The power factor must be not less than 90 percent when the ballast is operated at the nominal line voltage with a nominally-rated reference lamp. The lamp wattage regulation spread must not vary by more than  $\pm 6$  percent for  $\pm 10$  percent input voltage variation from nominal through life.

At the line voltage, the ballast must have a lamp current crest factor not exceeding 1.8 and ballast loss not exceeding 24 percent for a 180 W ballast.

The ballast must include a multi-circuit connector for quick disconnection.

**86-1.02K(4) Reserved**

**86-1.02L Reserved**

**86-1.02M Photoelectric Controls**

Photoelectric control types are as shown in the following table:

<b>Photoelectric Control Types</b>	
Control type	Description
I	Pole-mounted photoelectric unit. Test switch housed in an enclosure.
II	Pole-mounted photoelectric unit. Contactor and test switch located in a service equipment enclosure.
III	Pole-mounted photoelectric unit. Contactor and a test switch housed in an enclosure.
IV	A photoelectric unit that plugs into a NEMA twist-lock receptacle, integral with the luminaire.
V	A photoelectric unit, contactor, and test switch located in a service equipment enclosure.

The pole-mounted adaptor for Type I, II, and III photoelectric controls must include a terminal block and cable supports or clamps to support the wires.

The enclosure for Type I and III photoelectric controls must be a NEMA 3R type. The enclosure must have a factory-applied, rust-resistant prime coat and finish coat. The enclosure must be hot-dip galvanized or painted to match the color of the lighting standard.

Photoelectric unit must:

1. Have a screen to prevent artificial light from causing cycling.
2. Have a rating of 60 Hz, 105-130 V(ac), 210-240 V(ac), or 105-240 V(ac).
3. Operate at a temperature range from -20 to 55 degrees C.
4. Consume less than 10 W.
5. Be a 3-prong, twist-lock type with a NEMA IP 65 rating, ANSI C136.10-compliant
6. Have a fail-on state
7. Fit into a NEMA-type receptacle
8. Turn on from 1 to 5 footcandles and turn off from 1.5 to 5 times the turn-on level. Measurements must be made by procedures in *EEI-NEMA Standards for Physical and Electrical Interchangeability of Light-Sensitive Control Devices Used in the Control of Roadway Lighting*.

Type I, II, III, and V photoelectric controls must have a test switch to allow manual operation of the lighting circuit. Switch must be:

1. Single-hole mounting, toggle type
2. Single pole and single throw
3. Labeled *Auto-Test* on a nameplate

Photoelectric control's contactor must be:

1. Normally open
2. Mechanical-armature type with contacts of fine silver, silver alloy, or equal or better material
3. Installed to provide a minimum space of 2-1/2 inches between the contactor terminals and the enclosure's sides

The terminal blocks must be rated at 25 A, 600 V(ac), molded from phenolic or nylon material, and be the barrier type with plated-brass screw terminals and integral marking strips.

#### **86-1.02N Fused Splice Connectors**

The fused splice connector for 240 and 480 V(ac) circuits must simultaneously disconnect both ungrounded conductors. The connector must not have exposed metal parts except for the head of the stainless steel assembly screw. The head of the assembly screw must be recessed a minimum of 1/32 inch below the top of the plastic boss that surrounds the head.

The connector must protect the fuse from water or weather damage. Contact between the fuse and fuse holder must be spring loaded.

Fuses must:

1. Be standard, midget, ferrule type
2. Have a nontime-delay feature
3. Be 3/32 by 1-1/2 inches

#### **86-1.02O Grounding Electrodes**

Grounding electrode must be:

1. 1 piece
2. Minimum 10-foot length of one of the following:
  - 2.1. Galvanized steel rod or pipe not less than 3/4 inch in diameter
  - 2.2. Copper clad steel rod not less than 5/8 inch in diameter

#### **86-1.02P Enclosures**

##### **86-1.02P(1) General**

The enclosures must be rated NEMA 3R and include a dead front panel and a hasp with a 7/16-inch-diameter hole for a padlock.

The enclosure's machine screws and bolts must not protrude outside the cabinet wall.

The fasteners on the exterior of an enclosure must be vandal resistant and not be removable. The exterior screws, nuts, bolts, and washers must be stainless steel.

##### **86-1.02P(2) Service Equipment Enclosures**

A service equipment enclosure must be factory wired and manufactured from steel and galvanized or have factory-applied, rust-resistant prime and finish coats, except Types II and III.

Type II and III service equipment enclosures must:

1. Be made of 0.125-inch minimum thickness 5052-H32 aluminum sheet complying with ASTM B209.
2. Be manufactured using gas metal arc welding with bare aluminum welding electrodes. The electrodes must comply with AWS A5.10 Class ER5356.

3. Be manufactured using welding procedures, welders, and welding operators that comply with the requirements for welding procedures, welders, and welding operators in AWS B2.1, "Specification for Welding Procedure and Performance Qualification."
4. Have full-seal weld exterior seams.
5. Exterior welds must be ground smooth and edges filed to a radius of at least 0.03 inch.
6. Have a surface finish that complies with MIL-A-8625 for a Type II, Class I coating, except the anodic coating must have a minimum thickness of 0.0007 inch and a minimum coating weight of 0.001 oz/sq in.

If a Type III enclosure houses a transformer of more than 1 kVA, the enclosure must have effective screened ventilation louvers of no less than 50 sq. in for each louver. The framed screen must be stainless no. 304 with a no. 10 size mesh and secured with at least 4 bolts.

The dead front panel on a Type III service equipment enclosure must have a continuous stainless steel or aluminum piano hinge. The panel must be secured with a latch or captive screws. No live part must be mounted on the panel.

The enclosure must be watertight and marked as specified in NEC to warn of potential electric-arc flash hazards.

Internal conductors for the photoelectric control unit must be 600 V(ac), 14 AWG (THHN) stranded machine tool wire. Where subject to flexing, 19 stranded wire must be used.

The meter area must be have a sealable, lockable, weather-tight cover that can be removed without the use of tools.

For Type III-A, III-B, and III-C enclosures, the meter socket must be a 5-clip type, and the landing lug must be suitable for multiple conductors.

For a Type III-D enclosure, the meter socket must be a 7-clip type, and the landing lug must be suitable for multiple conductors. The pedestal must comply with the Electric Utility Service Equipment Requirements Committee drawing no. 308 or 309.

Landing lugs must be (1) sized for the incoming service utility conductors, (2) compatible with either copper or aluminum conductors, and (3) made of copper or tin-plated aluminum. Live parts of the electrical equipment must be guarded against accidental contact.

The main and neutral busses of the enclosure must be made of tin-plated copper, be rated for 125 A, and be suitable for copper or aluminum conductors.

Each service equipment enclosure must have up to 2 main circuit breakers that will simultaneously disconnect ungrounded service-entrance conductors.

Circuit breaker for a service equipment enclosure must:

1. Be quick-break on either automatic or manual operation
2. Be trip indicating
3. Be internal-trip type
4. Be UL listed or NRTL certified and comply with UL 489 or equal
5. Be clearly marked with the frame size
6. Have an operating mechanism that is enclosed and trip-free from the operating handle on overload
7. Have the trip rating clearly marked on the operating handle
8. Have an interior made of copper

Circuit breakers used as disconnects must have a minimum interrupting capacity of 10,000 A, rms.

The interior of the enclosure must accept plug-in circuit breakers. A minimum of 6 standard single-pole circuit breakers, 3/4" nominal, must be provided for branch circuits.

Identify each circuit breaker and component by description using an engraved phenolic nameplate attached with stainless steel rivets or screws.

Nameplate must be installed:

1. Adjacent to the breaker on the dead front panel. The characters must be a minimum of 1/8 inch high.
2. Adjacent to the component on the back panel. The characters must be a minimum of 1/8 inch high.
3. At the top exterior of the door panel. The nameplate must include the system number, voltage, and number of phases engraved in minimum 3/16-inch-high characters.

A plastic-laminated wiring diagram must be attached inside the enclosure with brass eyelets by a UL-listed or NRTL-certified method.

#### **86-1.02P(3) Lighting and Sign Illumination Enclosures**

A lighting and sign illumination enclosure must be manufactured from steel and either galvanized, cadmium plated, or powder coated.

#### **86-1.02Q Cabinets**

##### **86-1.02Q(1) General**

Cabinets must be factory wired except for battery backup system cabinets.

The fasteners on the exterior of a cabinet, except for battery backup system cabinets, must be removable and vandal resistant. The exterior screws, nuts, bolts, and washers must be stainless steel.

Terminal blocks, circuit breakers, and a power supply must be UL approved.

##### **86-1.02Q(2) Department-Furnished Controller Cabinets**

A Department-furnished controller assembly consists of a Model 170E or 2070E controller unit, a wired controller cabinet, and all auxiliary equipment required to operate the system. The Department does not furnish anchor bolts.

##### **86-1.02Q(3) Controller Cabinets**

The controller cabinet must be a Model 334L, comply with TEES, and be on the Authorized Material List for traffic signal control equipment. The cabinet must have 3 drawer shelves. Each shelf must be attached to the tops of 2 supporting angles with 4 screws.

##### **86-1.02Q(4) Telephone Demarcation Cabinets**

###### **86-1.02Q(4)(a) General**

The doors of a telephone demarcation cabinet must be attached using continuous stainless steel piano hinges.

###### **86-1.02Q(4)(b) Type A Telephone Demarcation Cabinets**

Reserved

###### **86-1.02Q(4)(c) Type B Telephone Demarcation Cabinets**

A Type B telephone demarcation cabinet consists of a mounting panel, outlets, circuit breaker, fan, dead front plates, and fuse.

The mounting panel must be made of 3/4-inch-thick ACX-grade plywood.

The mounting panel must be fastened to the cabinet with nuts, lock washers, and flat washers to 10 welded studs.

The cabinet must be made of 0.125-inch-thick anodized aluminum.

The cabinet door must be hung and secured with drawn latches, lockable with a padlock. The padlock latches must each have a minimum 7/16-inch-diameter hole.

Ventilation louvers must be located on the door.

The fan must be located in a ventilator housing and be controlled thermostatically. The thermostat control must have a range from 80 to 130 degrees F.

The thermostat and fan circuit must be protected with a fuse rated for 175 percent of the motor capacity. The fan capacity must be a minimum 25 cfm.

## **86-1.02Q(4)(d) Type C Telephone Demarcation Cabinets**

Reserved

## **86-1.02Q(5) Battery Backup System Cabinets**

The cabinet for a battery backup system must comply with TEES and be on the Authorized Material List for traffic signal control equipment.

## **86-1.02R Signal Heads**

### **86-1.02R(1) General**

A signal head consists of a signal mounting assembly, backplate, and signal face.

The head must have a terminal block attached to the back of one housing. The terminal block must have enough positions to accommodate all indications. Each position must be permanently labeled for the indications used.

The metal signal heads must not fracture or deflect more than half the lens diameter when tested under California Test 666.

The plastic signal heads must not fracture or deflect when tested under California Test 605.

The deflection must not be more than 10 degrees in either the vertical or horizontal plane after the wind load has been removed from the front of the signal face or more than 6 degrees in either the vertical or horizontal plane after the wind load has been removed from the back of the signal face.

### **86-1.02R(2) Signal Mounting Assemblies**

Signal mounting assembly must include:

1. 1-1/2-inch-diameter steel pipe or galvanized conduit
2. Pipe fitting made of ductile iron, galvanized steel, bronze, or aluminum alloy, Type AC-84B, no. 380
3. Mast arm and post-top slip fitters and terminal compartments made of cast bronze or hot-dip galvanized ductile iron

The horizontal distance between the vertical centerlines of the terminal compartment or slip fitter and of each signal face must not exceed 11 inches except where required for proper signal face alignment or to allow programming of programmed visibility signal sections.

The mounting assembly must be watertight and free of sharp edges or protrusions that might damage conductor insulation. The assembly must have positive-locking serrated fittings that prevent signal faces from rotating when the fittings are mated with similar fittings on the faces.

Each terminal compartment must be fitted with a terminal block having a minimum of 12 positions, each with 2 screw-type terminals. Each terminal must accommodate at least five no. 14 conductors. The terminal compartment must have a cover for easy access to the terminal block.

### **86-1.02R(3) Backplates**

The backplate material must be a homogeneous black color with a lusterless finish.

A metal backplate must be made of a minimum 1/16-inch-thick 3001-14 aluminum.

A plastic backplate must have a minimum thickness of 1/16 inch and be formed from sheet plastic or assembled from extruded, molded, or cast plastic sections. Sections must be factory joined using one of the following:

1. Appropriate solvent cement.
2. Aluminum rivets and washers painted or permanently colored to match the backplate.
3. No. 10 machine screws with flat washers, lock washers, and nuts painted to match the backplate.

Each plastic backplate must be secured to the plastic signal face such that it resists removal or permanent deformation.

### **86-1.02R(4) Signal Faces**

Signal face consists of signal sections with signal housings, LED modules, and visors.



Signal face must:

1. Be adjustable and allow for 360-degree rotation about the vertical axis
2. Comply with ITE publications ST-052-E, *Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Circular Signal Supplement* and ST-054, *Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement*
3. Be sealed with a neoprene gasket at the top opening

A metal signal face must have a metal backplate and visor.

A plastic signal face must have a plastic backplate and visor.

If a signal face is supported by a Type MAS slip fitter, spacers are required between the 2 sections. The spacers must be made of the same material as the housing. The vertical dimension of the spacers must allow proper seating of the serrations between the slip fitter and the 2 sections. The 2 sections must be joined with at least two no. 10 minimum machine screws through holes near the front of the housing and the spacers and matching holes in a reinforcing plate installed in the housing.

### **86-1.02R(4)(a) Signal Sections**

#### **86-1.02R(4)(a)(i) General**

Signal section must have:

1. Opening at the top and bottom for a 1-1/2-inch pipe
2. Maximum height of 10-1/4 inches for an 8-inch section and 14-3/4 inches for a 12-inch section
3. Hinge pins, door-latching devices, and other exposed hardware manufactured of Type 304/304L or 305 stainless steel
4. Interior screws and fittings manufactured of stainless steel or steel with a corrosion-resistant plating or coating
5. Gaskets made of a material that is not degraded if installed in a section with metal or plastic housing

Sections must be capable of being joined together to form a signal face in any combination. This interchangeability is not required between metal and plastic sections.

Each section must be joined to an adjacent section by one of the following:

1. Minimum of 3 machine screws for 8-inch sections and 4 machine screws for 12-inch sections, installed through holes near the front and back of the housing. Each screw must be a no. 10 and have a nut, flat washer, and lock washer.
2. 2 machine screws, each with a nut, flat washer, and lock washer, installed through holes near the front of the housing and a fastener through the 1-1/2-inch pipe opening. The fastener must have 2 large, flat washers to distribute the load around the pipe's opening and 3 carriage bolts, each with a nut and lock washer. The minimum screw size must be no. 10, and the carriage bolt size must be 1/4 inch.

The holes for the machine screws must be either cast or drilled during signal section fabrication. Each hole must be surrounded by a minimum 1/8-inch-wide boss to allow contact between signal sections about the axis of the hole.

A serrated nylon washer must be inserted between each plastic signal section and the metal mounting assembly. Each serrated nylon washer must be from 3/16 to 1/4 inch thick. The serrations must match those on the signal section and the mounting assembly.

#### **86-1.02R(4)(a)(ii) Programmed Visibility Signal Sections**

Programmed visibility signal section must have:

1. Nominal 12-inch-diameter circular or arrow indication
2. Cap visor
3. Adjustable connection that:
  - 3.1. Provides incremental tilting from 0 to 10 degrees above or below the horizontal
  - 3.2. Maintains a common vertical axis through couplers and mountings

The terminal connection must allow external adjustment about the mounting axis in 5-degree increments.

The visibility of each signal section must be capable of adjustment or programming within the section.

The adjustment for the section must be preset at 4 degrees below the horizontal.

**86-1.02R(4)(a)(iii) Signal Housings**

The signal housing must:

1. Be die-cast aluminum, permanent mold-cast aluminum, or if specified, structural plastic
2. Comply with ITE publications ST-052-E, *Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Circular Signal Supplement* and ST-054, *Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement* if made of die-cast or permanent mold-cast aluminum
3. Have a 1-piece, hinged, square-shaped door that is:
  - 3.1. Designed to allow access for replacement of modules without the use of tools
  - 3.2. Secured such that it remains closed during loading tests
4. Have a watertight module or lens mounted in the door
5. Have a terminal block attached to the back, with the terminals permanently labeled for conductors to facilitate field wiring

Each housing must have reinforcement plates. Reinforcement plates must be either sheet aluminum, galvanized steel, or cast aluminum. Each plate must have a minimum thickness of 0.11 inch and a hole concentric with a 1-1/2-inch pipe-mounting hole in the housing. Reinforcement plates must be placed as specified in the following table:

**Reinforcement Plate Placement**

Material	Placement
Sheet aluminum	Inside and outside of housing
Galvanized steel	Inside of housing
Cast aluminum	Outside of housing

Reinforcement plates placed outside of the housing must be finished to match the signal housing color and be designed to allow a proper serrated coupling between the signal face and the mounting hardware. A minimum of three no. 10 machine screws must be installed through holes in each plate and matching holes in the housing. Each screw must have a round or binder head, a nut, and a lock washer.

A metal housing must have a metal visor.

Plastic housing must:

1. Be molded in a single piece or fabricated from 2 or more pieces joined into a single piece
2. Be a black color throughout, including the door, matching color no. 17038, 27038, or 37038 of FED-STD-595
3. Have UV stability
4. Be self-extinguishing

If reinforcing webs are used to connect the back of the housing to the top, bottom, and sides of the adjacent housing, reinforcement plates are not required.

The exterior of the housing must be painted as specified in sections 78-4.08 and 59.

**86-1.02R(4)(b) LED Signal Modules**

An LED signal module must be on the Authorized Material List for LED traffic signal modules.

An LED signal module must comply with ITE publications ST-052-E, *Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Circular Signal Supplement* and ST-054, *Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement*, except:

1. Maximum module weight must be 4 lb
2. Module must be a sealed unit with:

- 2.1. 2 color-coded conductors for the power connection except lane control modules must use 3 color-coded conductors
- 2.2. Printed circuit board that complies with TEES, chapter 1, section 6
- 2.3. Lens that is:
  - 2.3.1. Convex or flat with a smooth outer surface
  - 2.3.2. Made of UV-stabilized plastic or glass
- 2.4. 1-piece EPDM gasket
3. Module must include 3-foot-long conductors with attached quick-disconnect terminals
4. Identification must include:
  - 4.1. Month and year of manufacture
  - 4.2. 1-inch-diameter symbol of the module type with the module color written adjacent to the symbol in 0.50-inch-high letters
5. LED must be the ultra-bright type rated for 100,000 hours of continuous operation
6. Module must have an integral power supply

Individual LEDs must be wired such that a loss or failure of 1 LED will not result in a loss of more than 5 percent of the module's light output. Failure of an individual LED in a string must not result in a loss of an entire string or other indication.

The symbol for a 12-inch U-turn section must be a 15/16-inch-wide inverted *U* with an arrow on the left end.

A lane control section must be a combination module with a red *X* and green arrow. The conductor function and color code must be as shown in the following table:

**Conductor Function and Color Code**

Function	Color
Neutral	White
Red <i>X</i>	Red
Green arrow	Brown

The minimum power consumption for an LED signal module must be 5 W.

The maximum power consumption for an LED signal module must be as shown in the following table:

**Maximum Power Consumption**

LED signal module type	Power consumption (W)					
	Red		Yellow		Green	
	25 °C	74 °C	25 °C	74 °C	25 °C	74 °C
8-inch circular	8	13	13	16	12	12
12-inch circular	11	17	22	25	15	15
12-inch arrow	9	12	10	12	11	11
12-inch U-turn	9	12	10	12	11	11
Bicycle	11	17	22	25	15	15
Programmed visibility	11	17	22	25	15	15
Lane control ( <i>X</i> )	9	12	--	--	--	--
Lane control ( <i>Arrow</i> )	--	--	--	--	11	11

Red and green LED signal modules operating over a temperature range from -40 to 74 degrees C and yellow LED signal modules operating at 25 degrees C must maintain the minimum illumination values for 48 months as shown in the following tables:

**Minimum Maintained Intensities for Circular Indications**

Angle (v,h)	Intensities (cd)					
	8-inch			12-inch		
	Red	Yellow	Green	Red	Yellow	Green
2.5, ±2.5	133	267	267	339	678	678
2.5, ±7.5	97	194	194	251	501	501
2.5, ±12.5	57	113	113	141	283	283
2.5, ±17.5	25	48	48	77	154	154
7.5, ±2.5	101	202	202	226	452	452
7.5, ±7.5	89	178	178	202	404	404
7.5, ±12.5	65	129	129	145	291	291
7.5, ±17.5	41	81	81	89	178	178
7.5, ±22.5	18	37	37	38	77	77
7.5, ±27.5	10	20	20	16	32	32
12.5, ±2.5	37	73	73	50	101	101
12.5, ±7.5	32	65	65	48	97	97
12.5, ±12.5	28	57	57	44	89	89
12.5, ±17.5	20	41	41	34	69	69
12.5, ±22.5	12	25	25	22	44	44
12.5, ±27.5	9	16	16	16	32	32
17.5, ±2.5	16	32	32	22	44	44
17.5, ±7.5	14	28	28	22	44	44
17.5, ±12.5	10	20	20	22	44	44
17.5, ±17.5	9	16	16	22	44	44
17.5, ±22.5	6	12	12	20	41	41
17.5, ±27.5	4	9	9	16	32	32

**Minimum Maintained Luminance for Indications**

Indication type	Luminance (fL)		
	Red	Yellow	Green
Arrow	1,610	3,210	3,210
U-turn	1,610	3,210	3,210
Bicycle	1,610	1,610	1,610
Lane control (X)	1,610	--	--
Lane control (Arrow)	--	--	1,610

**Minimum Maintained Luminance for Programmed Visibility Indications**

Indication type	Luminance (cd)		
	Red	Yellow	Green
PV at angle v=2.5, h=±2.5	314	314	314

Conductors must be prewired to the terminal block.

**86-1.02R(4)(c) Visors and Directional Louvers**

The visor must be a tunnel type.

The visor must have a downward tilt from 3 to 7 degrees with a minimum length of 9-1/2 inches for nominal 12-inch round lenses and 7 inches for nominal 8-inch round lenses.

A metal visor must be formed from minimum 0.050-inch-thick aluminum alloy sheet.

A plastic visor must be either formed from sheet plastic or blow-molded. The plastic must be a black homogeneous color with a lusterless finish. A visor must withstand a wind load applied to its side for 24

hours without permanent deformation or removal from its door when tested under California Test 605 for plastic visors and California Test 666 for metal visors.

If directional louvers are used, the louvers must fit into full-circular signal visors. Louvers must consist of one of the following:

1. Outside cylinder constructed of sheet steel with a minimum nominal thickness of 0.030 inch and vanes constructed of sheet steel with a minimum nominal thickness of 0.016 inch.
2. Outside cylinder and vanes constructed of 5052-H32 aluminum alloy of equal thickness.

### **86-1.02S Pedestrian Signal Heads**

#### **86-1.02S(1) General**

A pedestrian signal head consists of a pedestrian signal mounting assembly and a pedestrian signal face comprising of a pedestrian signal housing, an LED countdown pedestrian signal face module, and a front screen.

#### **86-1.02S(2) Pedestrian Signal Mounting Assemblies**

A pedestrian signal mounting assembly must comply with the specifications for a signal mounting assembly in section 86-1.02R, except mast arm slip fitters are not required.

#### **86-1.02S(3) Pedestrian Signal Faces**

##### **86-1.02S(3)(a) General**

Each pedestrian signal face must include a light-duty terminal block rated at 5 A and have 12 positions with no. 6-by-1/8-inch binder head screws. Each position must have 1 screw-type terminal.

The wiring and terminal block must comply with ITE publication ST-055-E, *Pedestrian Traffic Control Signal Indicators: Light Emitting Diode (LED) Signal Modules*.

##### **86-1.02S(3)(b) Pedestrian Signal Housings**

Pedestrian signal housing must comply with the specifications for a signal housing in 86-1.02R(4)(a)(iii), except the maximum overall dimensions must be 18-1/2 inches wide, 19 inches high, and 11-1/2 inches deep and without:

1. Visor
2. Watertight module or lens mounted in the door
3. Reinforcement plates

The housing must have a terminal block attached to the back. The terminal block must have enough positions to accommodate all indications. Each position must be permanently labeled for the indications used.

##### **86-1.02S(3)(c) LED Countdown Pedestrian Signal Face Modules**

An LED countdown PSF module must comply with ITE publication ST-055-E, *Pedestrian Traffic Control Signal Indicators: Light Emitting Diode (LED) Signal Modules*, except the material must comply with ASTM D3935 and the module must have:

1. Ultra-bright-type LED rated for 100,000 hours of continuous operation.
2. Lot number and month and year of manufacture permanently marked on the back of the module
3. Prominent and permanent vertical markings for accurate indexing and orientation within the pedestrian signal housing if a specific mounting orientation is required. Markings must be a minimum of 1 inch in height and include an up arrow and the word *up* or *top*.
4. Circuit board complying with TEES, chapter 1, section 6.

Individual LEDs must be wired such that a loss or failure of 1 LED will not result in a loss of more than 5 percent of the module's light output. Failure of an individual LED in a string must not result in a loss of an entire string or other indication.

Each symbol must be at least 9 inches high and 5-1/4 inches wide. The 2-digit countdown timer, *Upraised Hand*, and *Walking Person* indications must be electronically isolated from each other. The 3 indications must not share a power supply or interconnect circuitry.

The module must operate over the specified ambient temperature and voltage range and be readable both day and night at distances up to the full width of the area to be crossed. Upon initial testing at 25 degrees C, the module must have at least the luminance values shown in the following table:

PSF module symbol	Luminance
Upraised hand and 2-digit countdown timer (fL)	1,094
Walking person (fL)	1,547

The module must not exceed the power consumption requirements shown in the following table:

PSF module display	At 24 °C	At 74 °C
<i>Upraised Hand</i>	10.0 W	12.0 W
<i>Walking Person</i>	9.0 W	12.0 W
2-digit countdown timer	6.0 W	8.0 W

**86-1.02S(3)(d) Front Screen**

Pedestrian signal face must have a front screen that is one of the following types:

1. 3/8-inch-thick aluminum honeycomb screen with 0.2-inch-wide cells or a 1/2-inch-thick plastic screen with 3/8-inch-wide squares with 1/16-inch wall thickness that:
  - 1.1. Is installed so it tilts downward at an angle of  $15 \pm 2$  degrees from the top and completely covers the message plate.
  - 1.2. Includes a clear front cover made of either a minimum 1/8-inch-thick acrylic plastic sheet or a minimum 1/16-inch-thick polycarbonate plastic.
  - 1.3. Is held firmly in place, including the cover, with stainless steel or aluminum clips or stainless steel metal screws.
2. Polycarbonate screen that:
  - 2.1. Has a nominal thickness of 1/32 inch.
  - 2.2. Is a 1-1/2-inch-deep eggcrate or Z-crate type.
  - 2.3. Is mounted in a frame constructed of aluminum alloy or polycarbonate with a minimum thickness of 0.040 inch.
  - 2.4. Is held in place with stainless steel screws.

The screen and frame of a pedestrian signal face must be made of either (1) plastic that is a flat black color or (2) anodized aluminum that is a flat black color or finished with lusterless, black, exterior-grade latex paint formulated for application to metal surfaces.

**86-1.02T Accessible Pedestrian Signals**

Accessible pedestrian signal must comply with the *California MUTCD*, chapter 4E, and have:

1. Audible speech message that plays when the push button is actuated. The message must include the name of the street to be crossed. The accessible pedestrian signal must have at least 5 audible message options.
2. Push button locator tone that clicks or beeps.
3. Feature that activates the pedestrian phase during a failure of the audible message, locator tone, or vibrotactile device.

An accessible pedestrian signal must function with the Department-furnished Model 170E/2070E controller assembly.

No part of the accessible pedestrian signal must be installed inside the controller cabinet. Power for the accessible pedestrian signal must be from the pedestrian signal housing terminal block.

The housing for the signal assembly must be made of corrosion-resistant material. Theft-proof bolts used for mounting the housing to the standard must be stainless steel with a content of 17 percent chromium and 8 percent nickel. The housing must be shaped to fit the pole's curvature.

The color of a metallic housing must match color no. 33538 of FED-STD-595.

The color of a plastic housing must match color no. 17038, 27038, or 37038 of FED-STD-595.

Accessible pedestrian signal must:

1. Have electronic switches, a potentiometer, or an access port for a device for controlling and programming the volume level and messaging
2. Be weatherproof and shockproof

Enclosure for the accessible pedestrian signal must:

1. Weigh less than 7 lb
2. Measure less than 16 by 6 by 5 inches
3. Have a wiring hole with a diameter not exceeding 1-1/8 inches
5. Have a switch for a push button
6. Have a vibrotactile device on the push button or on the arrow
7. Have an internal weatherproof speaker and microphone that senses the ambient sound level

The separation between adjacent holes used for conductors and mounting must be at least twice the diameter of the larger hole.

The speaker grills must be located on the surface of the enclosure. The speakers must not interfere with the housing or its mounting hardware.

The conductor cable between the accessible pedestrian signal assembly and the pedestrian signal head must be a 9 no. 20 conductor cable complying with MIL-W-16878D.

#### **86-1.02U Push Button Assemblies**

The housing for a push button assembly must be made of die-cast aluminum, permanent mold-cast aluminum, or UV-stabilized self-extinguishing structural plastic. The plastic housing must have a color throughout that matches color no. 17038, 27038, or 37038 of FED-STD-595.

If the push button is to be attached to a pole, the housing must be shaped to fit the pole's curvature.

The assembly must be waterproof and shockproof.

The push button's switch must be a single-pole, double-throw switching unit with screw-type terminals rated 15 A at 125 V(ac).

Switch for the push button must have:

1. Plunger actuator and a U frame to allow recessed mounting in the push button housing
2. Operating force of 3.5 lb
3. Maximum pretravel of 5/64 inch
4. Minimum overtravel of 1/32 inch
5. Differential travel from 0.002 to 0.04 inch
6. Minimum 2-inch diameter actuator

#### **86-1.02V Reserved**

#### **86-1.02W Loop Detector Sealants**

##### **86-1.02W(1) General**

Sealant for filling loop detector slots must be one of the following:

1. Asphaltic emulsion
2. Elastomeric sealant
3. Epoxy sealant for inductive loops
4. Hot-melt rubberized asphalt

##### **86-1.02W(2) Asphaltic Emulsion Sealant**

Asphaltic emulsion sealant must comply with the State Specification 8040-41A-15.

### 86-1.02W(3) Elastomeric Sealant

Elastomeric sealant must be a polyurethane material that cures only in the presence of moisture if used within the stated shelf life. The sealant must be suitable for use in both asphalt concrete and concrete pavement.

The cured elastomeric sealant must comply with the requirements shown in the following table:

**Cured Elastomeric Sealant Requirements**

Quality characteristic	Test method	Requirement
Hardness	ASTM D2240 <sup>a</sup>	65–85
Tensile strength (min, MPa)	ASTM D412 <sup>b</sup>	3.45
Elongation (min, %)		400
Flex at -40 °C <sup>c</sup>	--	No cracks
Weathering resistance	ASTM D822 <sup>d</sup>	Slight chalking
Salt spray resistance:	ASTM B117 <sup>e</sup>	
Tensile strength (min, MPa)		3.45
Elongation (min, %)		400
Dielectric constant (%)	ASTM D150 <sup>f</sup>	<25

<sup>a</sup>Indentation at 25 °C and 50% relative humidity (Rex. Type A, Model 1700 only)

<sup>b</sup>Die C pulled at 508 mm/minute

<sup>c</sup>0.6-mm free film bend (180°) over 13-mm mandrel

<sup>d</sup>Weatherometer 350 h, cured 7 days at 25 °C and 50% relative humidity

<sup>e</sup>28 days at 38 °C with 5% NaCl, Die C, and pulled at 508 mm/minute)

<sup>f</sup>Change over a temperature range from -30 to 50 °C

### 86-1.02W(4) Hot-Melt Rubberized Asphalt Sealant

Hot-melt rubberized asphalt sealant must:

1. Be in solid form at room temperature and fluid at an application temperature range from 190 to 205 degrees C
2. Not produce toxic fumes
3. Be suitable for use in both asphalt concrete and concrete pavement
4. Be packaged in containers clearly marked *Detector Loop Sealant* with the manufacturer's batch and lot number.

The cured hot-melt rubberized asphalt sealant must comply with the requirements shown in the following table:

**Cured Hot-Melt Rubberized Asphalt Sealant Requirements**

Quality characteristic	Test method	Requirement
Cone penetration (max, 1/10 mm)	ASTM D5329, sec. 6 <sup>a</sup>	35
Flow (max, mm)	ASTM D5329, sec. 8 <sup>b</sup>	5
Resilience (min, %)	ASTM D5329, sec. 12 <sup>c</sup>	25
Softening point (min, °C)	ASTM D36	82
Ductility (min, cm)	ASTM D113 <sup>d</sup>	30
Flash point, Cleveland Open Cup (min, °C)	ASTM D92	288
Viscosity (Pa·s)	ASTM D4402 <sup>e</sup>	2.5–3.5

<sup>a</sup>At 25 °C, 150 g, 5 s

<sup>b</sup>At 60 °C

<sup>c</sup>At 25 °C

<sup>d</sup>At 25 °C, 5 cm/minute

<sup>e</sup>Brookfield Thermosel, no. 27 spindle, 20 rpm, 190 °C

### 86-1.02X Reserved

### 86-1.02Y Transformers

A transformer must be single-phase and may be a nonsubmersible or submersible type.



A transformer must be a dry type designed for operation on a 60 Hz supply. The transformer must have a decal showing a connection diagram. The diagram must show either color coding or wire tagging with primary (H1, H2) or secondary (X1, X2) markers and the primary and secondary voltage and volt-ampere rating. A transformer must comply with the electrical requirements shown in the following table:

**Transformer Electrical Requirements**

Quality characteristic	Requirement
Rating (V(ac))	120/480, 120/240, 240/480, or 480/120
Efficiency (%)	> 95
Secondary voltage regulation and tolerance from half load to full load (%)	±3

Secondary 240 and 480 V(ac) windings must be center tapped.

The transformer must withstand the application of 2,200 V(ac) from core to coils and from coil to coil for a 1-minute period when tested immediately after operation of the transformer at full load for 24 hours.

The external leads for the secondary connections must be no. 10 Type USE rated for 600 V(ac).

The transformer's leads must extend a minimum of 12 inches from the case.

The transformer's insulation must be NEMA 185 C or better.

Each transformer must:

1. Include metal half-shell coil protection.
2. Have moisture-resistant, synthetic-varnish-impregnated windings.
3. Be waterproof and suitable for outdoor operation.

Each submersible transformer must:

1. Include a handle and a hanger.
2. Be securely encased in a rugged, corrosion-resistant, watertight case.
3. Have leads that extend out through 1 or more sealed hubs.
4. Be manufactured to withstand a 5-day test with 12-hour on and off periods submerged in 2 feet of salt water that is 2 percent salt by weight. The operating periods must be at full load.

**86-1.02Z Batteries**

Battery must:

1. Be deep-cycle, sealed, prismatic, lead-calcium-based, absorbed-glass-mat, valve-regulated, lead-acid type
2. Be rated for 12 V
3. Be rated for a temperature range from -25 to 60 degrees C
4. Be group size 24
5. Be commercially available and stocked locally
6. Be marked with a date code, maximum recharge data, and recharge cycles
7. Be new and fully charged when furnished
8. Be free from damage or deformities
9. Have a carrying handle
10. Have 2 top-mounted, threaded-stud posts that include all washers and nuts
11. Include insulating rubber covers for protecting the lugs, posts, and wiring: red for the positive terminal and black for the negative terminal

If a battery is used for a battery backup system, it must accommodate 3/8-inch ring lugs of a Department-furnished battery harness.

**86-1.03 CONSTRUCTION**

Not Used

**86-1.04 PAYMENT**

Not Used

Replace section 87 with:

04-15-16

**87 ELECTRICAL SYSTEMS**

04-15-16

**87-1 GENERAL**

**87-1.01 GENERAL**

**87-1.01A Summary**

Section 87 includes general specifications for constructing and installing electrical systems.

The Department deducts the cost for maintenance performed by the Department on new or portions of existing systems modified under the Contract.

**87-1.01B Definitions**

Reserved

**87-1.01C Submittals**

Reserved

**87-1.01D Quality Assurance**

**87-1.01D(1) General**

Reserved

**87-1.01D(2) Quality Control**

Before shipping the material to the job site, submit to METS test samples of:

1. Accessible pedestrian signals
2. LED countdown pedestrian signal face modules
3. LED signal modules
4. LED luminaires

Submit a sample size as shown in the following table:

**Electrical Material Sampling**

Contract quantity	Test sample size
1–8	1
9–15	2
16–25	3
26–90	5
91–150	8
151–280	13
281–500	20
501–1200	32

Before starting operation of an electrical system, perform a conductor test in the presence of the Engineer.

Conductor test consists of testing each conductor and the conductors in cables for:

1. Continuity.
2. Grounds.
3. Insulation resistance at 500 V(dc) between the circuit and ground. The insulation resistance must be a minimum of 10 MΩ on circuits, except it must be a minimum of 100 MΩ for inductive loop detector circuits.

Start the operational test of the system on any day except Friday or the day before a holiday. The operational test for signals must start from 9:00 a.m. to 2:00 p.m. Notify the Engineer 48 hours before starting the test.

An operational test consists of a minimum of 5 business days of continuous, satisfactory operation of the system. If the system fails, correct the problem and retest the system. A shutdown of the system caused by traffic, a power interruption, or unsatisfactory performance of Department-furnished materials does not constitute discontinuity of the test.

### **87-1.02 MATERIALS**

Not Used

### **87-1.03 CONSTRUCTION**

#### **87-1.03A General**

The Engineer determines the final locations of electrical systems.

Verify the locations of electrical systems and the depths of existing detectors, conduits, and pull boxes.

Notify the Engineer before performing work on the existing system.

You may shut down the system for alteration or removal.

Where an existing Department underground facility is shown within 10 feet of any excavation, locate and field mark the facility before performing work that could damage or interfere with the existing facility.

If an existing facility is within 2 feet of an excavation, determine the exact location of the facility by excavating with hand tools before using any power-operated or power-driven excavating or boring equipment. A vacuum excavator may be used if authorized.

Notify the Engineer immediately if an existing facility is damaged by your activities.

If existing underground conduit is to be incorporated into a new system, clean it with a mandrel or cylindrical wire brush and blow it clean with compressed air.

Limit the shutdown of traffic signal systems to normal working hours. Notify the local traffic enforcement agency before shutting down the signal.

Place temporary W3-1 and R1-1 signs in each direction to direct traffic through the intersection during shutdown of the signal. Place two R1-1 signs for 2-lane approaches. The signs must comply with part 2 of the *California MUTCD*.

Cover signal faces when the system is shut down overnight. Cover temporary W3-1 and R1-1 signs when the system is turned on.

If you work on an existing lighting system and the roadway is to remain open to traffic, ensure the system is in operation by nightfall.

Replace detectors you damage within 72 hours, or the Department replaces them and deducts the cost.

Work performed on an existing system not described is change order work.

Do not use electrical power from existing highway facilities unless authorized.

Maintain a minimum 48-inch clearance for a pedestrian pathway when placing equipment.

Except for service installation or work on service equipment enclosures, do not work above ground until all materials are on hand to complete the electrical work at each location.

Bond all metal components to form a continuous grounded system as specified in NEC.

Ground metallic equipment mounted less than 8 feet above the ground surface on a wood pole.

If you damage any portion of a concrete curb, sidewalk, curb ramp, driveway, or gutter depression, replace the entire section between contraction or expansion joints under section 73.

Apply equipment identification characters.

Orient louvers, visors, and signal faces such that they are clearly visible to approaching traffic from the direction being controlled.

Test loops and the detector lead-in cable circuit for continuity, ground, and insulation resistance at the controller cabinet before connecting detector lead-in cable to the terminal block.

Perform an operational test of the systems.

Before starting the operational test for systems that impact traffic, the system must be ready for operation, and all signs, pavement delineation, and pavement markings must be in place at that location.

### **87-1.03B Conduit Installation**

#### **87-1.03B(1) General**

The installation of conduit includes installing caps, bushings, and pull tape and terminating the conduit in pull boxes, foundations, poles, or a structure.

Limit the number of bends in a conduit run to no more than 360 degrees between pull points.

Use conduit to enclose conductors except where they are installed overhead or inside standards or posts.

You may use a larger size conduit than specified for the entire length between termination points. Do not use a reducing coupling.

Extend an existing conduit using the same material. Terminate conduits of different materials in a pull box.

Install 2 conduits between a controller cabinet and the adjacent pull box.

Use a minimum trade size of conduit of:

1. 1-1/2 inches from an electrolier to the adjacent pull box
2. 1 inch from a pedestrian push button post to the adjacent pull box
3. 2 inches from a signal standard to the adjacent pull box
4. 3 inches from a controller cabinet to the adjacent pull box
5. 2 inches from an overhead sign to the adjacent pull box
6. 2 inches from a service equipment enclosure to the adjacent pull box
7. 1-1/2 inches if unspecified

Use Type 1 conduit:

1. On all exposed surfaces
2. In concrete structures
3. Between a structure and the nearest pull box

Ream the ends of shop-cut and field-cut conduit to remove burrs and rough edges. Make the cuts square and true. Do not use slip joints and running threads to couple conduit. If a standard coupling cannot be used for metal-type conduit, use a threaded union coupling. Tighten the couplings for metal conduit to maintain a good electrical connection.

Cap the ends of conduit to prevent debris from entering before installing the conductors or cables. Use a plastic cap for Type 1, 2, and 5 conduits and a standard pipe cap for all other types of conduit.

For Type 1, 2, and 5 conduits, use threaded bushings and bond them using a jumper. For other types of conduit, use nonmetallic bushings.

Do not install new conduit through foundations.

Cut Type 2 conduit with pipe cutters; do not use hacksaws. Use standard conduit-threading dies for threading conduit. Tighten conduit into couplings or fittings using strap wrenches or approved groove joint pliers.

Cut Type 3 conduit with tools that do not deform the conduit. Use a solvent weld for connections.

Protect shop-cut threads from corrosion under the standards shown in the following table:

Conduit	Standard
Types 1 and 2	ANSI C80.1
Type 5	ANSI C80.6

Apply 2 coats of unthinned, organic zinc-rich primer to metal conduit before painting. Use a primer on the Authorized Material List for organic zinc-rich primers. Do not use aerosol cans. Do not remove shop-installed conduit couplings.

For conduits, paint:

1. All exposed threads
2. Field-cut threads, before installing conduit couplings to metal conduit
3. Damaged surfaces on metal conduit

If a Type 2 conduit or conduit coupling coating is damaged:

1. Clean the conduit or fitting and paint it with 1 coat of rubber-resin-based adhesive under the manufacturer's instructions
2. Wrap the damaged coating with at least 1 layer of 2-inch-wide, 20 mils-minimum-thickness, PVC tape under ASTM D1000 with a minimum tape overlap of 1/2 inch

You may repair damaged spots of 1/4 inch or less in diameter in the thermoplastic coating by painting with a brushing-type compound supplied by the conduit manufacturer.

If factory bends are not used, bend the conduit to a radius no less than 6 times its inside diameter without crimping or flattening it. Comply with the bending requirements shown in the following table:

Type	Requirement
1	Use equipment and methods under the conduit manufacturer's instructions.
2	Use a standard bending tool designed for use on thermoplastic-coated conduit. The conduit must be free of burrs and pits.
3	Use equipment and methods under the conduit manufacturer's instructions. Do not expose the conduit to a direct flame.
5	Use equipment and methods under the conduit manufacturer's instructions.

Install pull tape with at least 2 feet of slack in each end of the conduit that will remain empty. Attach the tape's ends to the conduit.

Install conduit terminating in a standard or pedestal from 2 to 3 inches above the foundation. Slope the conduit toward the handhole opening.

Terminate conduit installed through the bottom of a nonmetallic pull box 2 inches above the bottom and 2 inches from the wall closest to the direction of the run.

### **87-1.03B(2) Conduit Installation for Structures**

#### **87-1.03B(2)(a) General**

Paint exposed Type 1 conduit the same color as the structure.

Install galvanized steel hangers, steel brackets, and other fittings to support conduit in or on a wall or bridge.

### **87-1.03B(2)(b) New Structures**

Seal and make watertight the conduits which lead to soffits, wall-mounted luminaires, other lights, and fixtures located below the pull box grade.

If you place a conduit through the side of a nonmetallic pull box, terminate the conduit 2 inches from the wall and 2 inches above the bottom. Slope the conduit toward the top of the box to facilitate pulling conductors.

For ease of installation and if authorized, you may use Type 4 conduit instead of Type 1 conduit for the final 2 feet of conduit entering a pull box in a reinforced concrete structure.

Install an expansion fitting where a conduit crosses an expansion joint in a structure. Each expansion fitting for metal conduit must include a copper bonding jumper having the ampacity as specified in NEC.

Install an expansion-deflection fitting for an expansion joint with a 1-1/2-inch movement rating. The fitting must be watertight and include a molded neoprene sleeve, a bonding jumper, and 2 silicon bronze or zinc-plated iron hubs.

For an expansion joint with a movement rating greater than 1-1/2 inches, install the expansion-deflection fitting as shown.

For conduit installed inside of bridge structures, you must:

1. Install precast concrete cradles made of minor concrete and commercial-quality welded wire fabric. The minor concrete must contain a minimum of 590 lb of cementitious material per cubic yard. The cradles must be moist cured for a minimum of 3 days.
2. Bond precast concrete cradles to a wall or bridge superstructure with one of the following:
  - 2.1. Epoxy adhesive for bonding freshly-mixed concrete to hardened concrete.
  - 2.2. Rapid-set epoxy adhesive for pavement markers.
  - 2.3. Standard-set epoxy adhesive for pavement markers.
3. Use a pipe sleeve or form an opening for a conduit through a bridge superstructure. The sleeve or opening through a prestressed member or conventionally reinforced precast member must be:
  - 3.1. Oriented transverse to the member.
  - 3.2. Located through the web.
  - 3.3. No more than 4 inches in size.
4. Wrap the conduit with 2 layers of asphalt felt building paper and securely tape or wire the paper in place for a conduit passing through a bridge abutment wall. Fill the space around the conduit with mortar under section 51-1, except the proportion of cementitious material to sand must be 1 to 3. Fill the space around the conduits after prestressing is completed.

Thread and cap a conduit installed for future use in structures. Mark the location of the conduit's end in a structure, curb, or wall directly above the conduit with a Y that is 3 inches tall.

### **87-1.03B(2)(c) Existing Structures**

Run surface-mounted conduit straight and true, horizontal or vertical on the wall, and parallel to walls on ceilings or similar surfaces. Support the conduit at a maximum of 5-foot intervals where needed to prevent vibration or deflection. Support the conduit using galvanized, malleable-iron, conduit clamps, and clamp backs secured with expansion anchorage devices complying with section 75-3.02C. Use the largest diameter of galvanized, threaded studs that will pass through the mounting hole in the conduit clamp.

### **87-1.03B(3) Conduit Installation Underground**

#### **87-1.03B(3)(a) General**

Install conduit to a depth of:

1. 14 inches for the trench-in-pavement method
2. 18 inches, minimum, under sidewalk and curbed paved median areas
3. 42 inches, minimum, below the bottom of the rail of railroad tracks

4. 30 inches, minimum, everywhere else below grade

Place conduit couplings at a minimum of 6 inches from the face of a foundation.

Place a minimum of 2 inches of sand bedding in a trench before installing Type 2 or Type 3 conduit and 4 inches of sand bedding over the conduit before placing additional backfill material.

If installing conduit within the limits of hazardous locations as specified in NEC for Class I, division 1, install and seal Type 1 or Type 2 conduit with explosion-proof sealing fittings.

#### **87-1.03B(3)(b) Conduit Installation under Paved Surfaces**

You may lay conduit on existing pavement within a new curbed median constructed on top.

Install conduit under existing pavement by the jacking or drilling methods. You may use the trench-in-pavement method for either of the following conditions:

1. If conduit is to be installed behind the curb under the sidewalk
2. If the delay to vehicles will be less than 5 minutes

Do not use the trench-in-pavement method for conduit installations under freeway lanes or freeway-to-freeway connector ramps.

#### **87-1.03B(3)(c) Reserved**

#### **87-1.03B(3)(d) Conduit Installation under Railroad Tracks**

Install Type 1 or Type 2 conduit with a minimum diameter of 1-1/2 inches under railroad tracks. If you use the jacking or drilling method to install the conduit, construct the jacking pit a minimum of 13 feet from the tracks' centerline at the near side of the pit. Cover the jacking pit with planking if left overnight.

#### **87-1.03B(4) Reserved**

#### **87-1.03B(5) Conduit Installation by the Jacking or Drilling Method**

Keep the jacking or drilling pit 2 feet away from the pavement's edge. Do not weaken the pavement or soften the subgrade with excessive use of water.

If an obstruction is encountered, obtain authorization to cut small holes in the pavement to locate or remove the obstruction.

You may install Type 2 or Type 3 conduit under the pavement if a hole larger than the conduit's diameter is predrilled. The predrilled hole must be less than one and half the conduit's diameter.

Remove the conduit used for drilling or jacking and install new conduit for the completed work.

#### **87-1.03B(6) Conduit Installation by the Trenching-In-Pavement Method**

Install conduit by the trenching-in-pavement method using a trench approximately 2 inches wider than the conduit's outside diameter but not exceeding 6 inches in width.

Where additional pavement is to be placed, you must complete the trenching before the final pavement layer is applied.

If the conduit shown is to be installed under the sidewalk, you may install it in the street within 3 feet of and parallel to the face of the curb. Install pull boxes behind the curb.

Cut the trench using a rock-cutting excavator. Minimize the shatter outside the removal area of the trench.

Dig the trench by hand to the required depth at pull boxes.

Place conduit in the trench.

Backfill the trench with minor concrete to the pavement's surface by the end of each work day. If the trench is in asphalt concrete pavement and no additional pavement is to be placed, backfill the top 0.10 foot of the trench with minor HMA within 3 days after trenching.

### **87-1.03C Installation of Pull Boxes**

#### **87-1.03C(1) General**

Install pull boxes no more than 200 feet apart.

You may install larger pull boxes than specified or shown and additional pull boxes to facilitate the work except in structures.

Install a pull box on a bed of crushed rock and grout it before installing conductors. The grout must be from 0.5 to 1 inch thick and sloped toward the drain hole. Place a layer of roofing paper between the grout and the crushed rock sump. Make a 1-inch drain hole through the grout at the center of the pull box.

Set the pull box such that the top is 1-1/4 inches above the surrounding grade in unpaved areas and leveled with the finished grade in sidewalks and other paved areas.

Place the cover on the box when not working in it.

Grout around conduits that are installed through the sides of the pull box.

Bond and ground the metallic conduit before installing conductors and cables in the conduit.

Bond metallic conduits in a nonmetallic pull box using bonding bushings and bonding jumpers.

Do not install pull boxes in concrete pads, curb ramps, or driveways.

Reconstruct the sump of a pull box if disturbed by your activities. If the sump was grouted, remove and replace the grout.

#### **87-1.03C(2) Nontraffic Pull Boxes**

If you bury a nontraffic pull box, set the box such that the top is 6 to 8 inches below the surrounding grade. Place a 20-mil-thick plastic sheet made of HDPE or PVC virgin compounds to prevent water from entering the box.

Place mortar between a nontraffic pull box and a pull box extension.

Where a nontraffic pull box is in the vicinity of curb in an unpaved area, place the box adjacent to the back of the curb if practical.

Where a nontraffic pull box is adjacent to a post or standard, place the box within 5 feet upstream from traffic if practical.

If you replace the cover on a nontraffic pull box, anchor it to the box.

#### **87-1.03C(3) Traffic Pull Boxes**

Place minor concrete around and under a traffic pull box.

Bolt the steel cover to the box when not working in it.

Bond the steel cover to the conduit with a jumper and bolt it down after installing the conductors and cables.

#### **87-1.03C(4) Structure Pull Boxes**

Bond metallic conduit in a metal pull box in a structure using locknuts, inside and outside of the box, bonding bushings, and bonding jumpers connected to bonding wire running in the conduit system.

#### **87-1.03D Reserved**

#### **87-1.03E Excavating and Backfilling for Electrical Systems**

##### **87-1.03E(1) General**

Notify the Engineer at least 72 hours before starting excavation activities.

Dispose of surplus excavated material.

Restrict closures for excavation on a street or highway to 1 lane at a time unless otherwise specified.



### **87-1.03E(2) Trenching**

Dig a trench for the electrical conduits or direct burial cables. Do not excavate until the conduit or direct burial cable will be installed.

Place excavated material in a location that will not interfere with traffic or surface drainage.

After placing the conduit or direct burial cable, backfill the trench with the excavated material. Compact the backfill placed outside the hinge point of slopes and not under pavement to a minimum relative compaction of 90 percent.

Compact the backfill placed within the hinge points and in areas where pavement is to be constructed to a minimum relative compaction of 95 percent.

Restore the sidewalks, pavement, and landscaping at a location before starting excavation at another location.

### **87-1.03E(3) Concrete Pads, Foundations, and Pedestals**

Construct foundations for standards, poles, metal pedestals, and posts under section 56-3.

Construct concrete pads, foundations, and pedestals for controller cabinets, telephone demarcation cabinets, and service equipment enclosures on firm ground.

Install anchor bolts using a template to provide proper spacing and alignment. Moisten the forms and ground before placing the concrete. Keep the forms in place until the concrete sets for at least 24 hours to prevent damage to the surface.

Use minor concrete for pads, foundations, and pedestals.

In unpaved areas, place the top of the foundation 6 inches above the surrounding grade, except place the top:

1. 1 foot 6 inches above the grade for Type M and 336L cabinets
2. 1 foot 8 inches above the grade for Type C telephone demarcation cabinets
3. 2 inches above the grade for Type G and Type A cabinets and Type III service equipment enclosures

The pad must be 2 inches above the surrounding grade.

In and adjacent to the sidewalk and other paved areas, place the top of the foundation 4 inches above the surrounding grade, except place the top:

1. 1 foot 6 inches above the grade for Type M and 336L cabinets
2. 1 foot 8 inches above the grade for Type C telephone demarcation cabinets
3. Level with the finished grade for Type G and Type A cabinets and Type III service equipment enclosures

The pad must be level with the finished grade.

Apply an ordinary surface finish under section 51-1.03F.

Allow the foundation to cure for at least 7 days before installing any equipment.

### **87-1.03F Conductors and Cable Installations**

#### **87-1.03F(1) General**

The installation of conductors and cables includes splicing conductors and attaching the terminals and connectors to the conductors.

Clean the conduit and pull all conductors and cables as a unit.

If new conductors or cables are to be added in an existing conduit:

1. Remove the content
2. Clean the conduit
3. Pull both old and new conductors and cables as a unit

Wrap conductors and secure cables to the end of the conduit in a pull box.

Seal the ends of conduits with a sealing compound after installing conductors or cables.

Neatly arrange conductors and cables inside pull boxes and cabinets. Tie the conductors and cables together with self-clinching nylon cable ties or enclose them in a plastic tubing or raceway.

Identify conductors and cables by direct labeling, tags, or bands fastened in such a way that they will not move. Use mechanical methods for labeling.

Provide band symbol identification on each conductor or each group of conductors comprising a signal phase in each pull box and near the end of terminated conductors.

Tape the ends of unused conductors and cables in pull boxes to form a watertight seal.

Do not connect the push-button or accessible pedestrian signal neutral conductor to the signal neutral conductor.

### **87-1.03F(2) Cables**

#### **87-1.03F(2)(a) General**

Reserved

#### **87-1.03F(2)(b) Reserved**

#### **87-1.03F(2)(c) Copper Cables**

##### **87-1.03F(2)(c)(i) General**

Reserved

##### **87-1.03F(2)(c)(ii) Detector Lead-in Cables**

Install a Type B or C detector lead-in cable in conduit.

Waterproof the ends of the lead-in cable before installing it in the conduit to prevent moisture from entering the cable.

Splice loop conductors for each direction of travel for the same phase, terminating in the same pull box, to a separate lead-in cable running from the pull box adjacent to the loop detector to a sensor unit mounted in the controller cabinet. Install the lead-in cable without splices except at the pull box.

Verify in the presence of the Engineer that the loops are operational before making the final splices between loop conductors and the lead-in cable.

Identify and tag each lead-in cable with the detector designation at the cabinet and pull box adjacent to the loops.

##### **87-1.03F(2)(c)(iii) Conductors Signal Cables**

Do not splice signal cables except for a 28-conductor cable.

Provide identification at the ends of terminated conductors in a cable as shown.

Provide identification for each cable in each pull box showing the signal standard to which it is connected except for the 28-conductor cable.

Connect conductors in a 12-conductor cable as shown in the following table:

### 12CSC Color Code and Functional Connection

Color code	Termination	Phase
Red	Red signal	2, 4, 6, or 8
Yellow	Yellow signal	2, 4, 6, or 8
Brown	Green signal	2, 4, 6, or 8
Red/black stripe	Red signal	1, 3, 5, or 7
Yellow/black stripe	Yellow signal	1, 3, 5, or 7
Brown/black stripe	Green signal	1, 3, 5, or 7
Black/red stripe	Spare or as required for red or <i>DONT WALK</i>	--
Black/white stripe	Spare or as required for yellow	--
Black	Spare or as required for green or <i>WALK</i>	--
Red/white stripe	Pedestrian signal <i>DONT WALK</i>	--
Brown/white stripe	Pedestrian signal <i>WALK</i>	--
White	Terminal block	Neutral

Provide identification for each 28-conductor cable C1 or C2 in each pull box. The cable labeled C1 must be used for signal phases 1, 2, 3, and 4. The cable labeled C2 must be used for signal phases 5, 6, 7, and 8.

Connect conductors in a 28-conductor cable as shown in the following table:

### 28CSC Color Code and Functional Connection

Color code	Termination	Phase
Red/black stripe	Red signal	2 or 6
Yellow/black stripe	Yellow signal	2 or 6
Brown/black stripe	Green signal	2 or 6
Red/orange stripe	Red signal	4 or 8
Yellow/orange stripe	Yellow signal	4 or 8
Brown/orange stripe	Green signal	4 or 8
Red/silver stripe	Red signal	1 or 5
Yellow/silver stripe	Yellow signal	1 or 5
Brown/silver stripe	Green signal	1 or 5
Red/purple stripe	Red signal	3 or 7
Yellow/purple stripe	Yellow signal	3 or 7
Brown/purple stripe	Green signal	3 or 7
Red/2 black stripes	Pedestrian signal <i>DONT WALK</i>	2 or 6
Brown/2 black stripes	Pedestrian signal <i>WALK</i>	2 or 6
Red/2 orange stripes	Pedestrian signal <i>DONT WALK</i>	4 or 8
Brown/2 orange stripes	Pedestrian signal <i>WALK</i>	4 or 8
Red/2 silver stripes	Overlap A, C	OLA <sup>a</sup> , OLC <sup>a</sup>
Brown/2 silver stripes	Overlap A, C	OLA <sup>c</sup> , OLC <sup>c</sup>
Red/2 purple stripes	Overlap B, D	OLB <sup>a</sup> , OLD <sup>a</sup>
Brown/2 purple stripes	Overlap B, D	OLB <sup>c</sup> , OLD <sup>c</sup>
Blue/black stripe	Pedestrian push button	2 or 6
Blue/orange stripe	Pedestrian push button	4 or 8
Blue/silver stripe	Overlap A, C	OLA <sup>b</sup> , OLC <sup>b</sup>
Blue/purple stripe	Overlap B, D	OLB <sup>b</sup> , OLD <sup>b</sup>
White/black stripe	Pedestrian push button common	--
Black/red stripe	Railroad preemption	--
Black	Spare	--
White	Terminal block	Neutral

OL = Overlap; A, B, C, and D = Overlapping phase designation

<sup>a</sup>For red phase designation

<sup>b</sup>For yellow phase designation

<sup>c</sup>For green phase designation

Use the neutral conductor only with the phases associated with that cable. Do not intermix neutral conductors from different cables except at the signal controller.

#### **87-1.03F(2)(c)(iv) Signal Interconnect Cable**

For a signal interconnect cable, provide a minimum of 6 feet of slack inside each controller cabinet.

Do not splice the cable unless authorized.

If splices are authorized, insulate the conductor splices with heat-shrink tubing and overlap the insulation at least 0.6 inch. Cover the splice area of the cable with heat-shrink tubing and overlap the cable jacket at least 1-1/2 inches. Provide a minimum of 3 feet of slack at each splice.

#### **87-1.03F(3) Conductors**

##### **87-1.03F(3)(a) General**

Do not run conductors to a terminal block on a standard unless they are to be connected to a signal head mounted on that standard.

Provide 3 spare conductors in all conduits containing ramp metering and traffic signal conductors.

Install a separate conductor for each terminal of a push button assembly and accessible pedestrian signal.

Provide conductor slack to comply with the requirements shown in the following table:

Location	Slack (feet)
Signal standard	1
Lighting standard	1
Signal and lighting standard	1
Pull box	3
Splice	3
Standards with slip base	0

**87-1.03F(3)(b) Reserved**

**87-1.03F(3)(c) Copper Conductors**

**87-1.03F(3)(c)(i) General**

Install a minimum no. 8, insulated, grounding copper conductor in conduit and connect it to all-metal components.

Where conductors from different service points occupy the same conduit or standard, enclose the conductors from one of the services in flexible or rigid metal conduit.

**87-1.03F(3)(c)(ii) Inductive Loop Conductors**

Install a Type 1 or 2 inductive loop conductor except use Type 2 for Type E loop detectors.

Install the conductor without splices except at the pull box.

**87-1.03F(4) Manual Installation Method**

Use an inert lubricant for placing conductors and cables in conduit.

Pull the conductors and cables into the conduit by hand using pull tape.

**87-1.03G Equipment Identification Characters**

The Engineer provides you with a list of the equipment identification characters.

Stencil the characters or apply the reflective self-adhesive labels to a clean surface.

Treat the edges of self-adhesive characters with an edge sealant.

Place the characters on the side facing traffic on:

1. Front doors of cabinets and service equipment enclosures.
2. Wood poles, fastened with 1-1/4-inch aluminum nails, for pole mounted enclosures
3. Adjacent bent or abutment at approximately the same station as an illuminated sign or soffit luminaire
4. Underside of the structure adjacent to the illuminated sign or soffit luminaire if no bent or abutment exists nearby
5. Posts of overhead signs
6. Standards

Before placing new characters on existing or relocated equipment, remove the existing characters.

**87-1.03H Conductor and Cables Splices**

**87-1.03H(1) General**

You may splice:

1. Grounded conductors in a pull box
2. Accessible pedestrian signal and push bottom conductors in a pull box
3. Ungrounded signal conductors in a pull box if signals are modified

4. Ungrounded signal conductors to a terminal compartment or a signal head on a standard with conductors of the same phase in the pull box adjacent to the standard
5. Ungrounded lighting circuit conductors in a pull box if lighting circuits are modified

Solder all splices using the hot iron, pouring, or dipping method. Do not perform open-flame soldering.

#### **87-1.03H(2) Splice Insulation Methods**

Insulate splices in a multiconductor cable to form a watertight joint and to prevent moisture absorption by the cable.

Use heat-shrink tubing or Method B to insulate a splice.

Use heat-shrink tubing as follows:

1. Cover the splice area completely with an electrical insulating coating and allow it to dry.
2. Place mastic around each conductor before placing them inside the tubing. Use the type of mastic specified in the tubing manufacturer's instructions.
3. Heat the area under the manufacturer's instructions. Do not perform open-flame heating. After contraction, each end of the heat-shrink tubing or the open end of the tubing's end cap must overlap the conductor insulation at least 1-1/2 inches.
4. Cover the entire splice with an electrical insulating coating and allow it to dry.

Use Method B as follows:

1. Cover the splice area completely with an electrical insulating coating and allow it to dry.
2. Apply 3 layers of half-lapped, 80-mils, PVC tape.
3. Apply 2 layers of 120-mils, butyl-rubber, stretchable tape with liner.
4. Apply 3 layers of half-lapped, 6-mils, PVC, pressure-sensitive, adhesive tape.
5. Cover the entire splice with an electrical insulating coating and allow it to dry.

#### **87-1.03I Connectors and Terminals**

Apply connectors and terminals to cables and conductors using a crimping compression tool under the manufacturer's instructions. The tool must prevent opening of the handles until the crimp is completed.

Install crimp-style terminal lugs on stranded conductors smaller than no. 14.

Solder no. 8 and smaller conductors to connectors and terminal lugs.

#### **87-1.03J Standards, Poles, Pedestals, and Posts**

Install standards, poles, pedestals, and posts under section 56-3.

Ground standards with a handhole by attaching a bonding jumper from the bolt or lug inside the standard to a metal conduit or to the grounding wire in the adjacent pull box. The bonding jumper must be visible when the handhole cover is removed.

Ground standards without a handhole or standards with a slip base by attaching a bonding jumper to all anchor bolts using ground clamps and connecting it to a metal conduit or to the grounding wire in the adjacent pull box. The bonding jumper must be visible after mortar has been placed on the foundation.

#### **87-1.03K Reserved**

#### **87-1.03L Utility Service**

##### **87-1.03L(1) General**

Install the service equipment early enough to allow the utility to complete its work before completion of the electrical work.

At least 15 days before permanent electrical and telecommunication service is required, request the service connections for permanent installations. The Department arranges with the utilities for completion of the connections and pays all costs and fees required by the utilities.

### **87-1.03L(2) Electric Service**

#### **87-1.03L(2)(a) General**

If service equipment is to be installed on a utility-owned pole, furnish and install the conduit, conductors, pull boxes, and other necessary material to complete the service installation. The service utility decides the position of the riser and equipment on the pole.

#### **87-1.03L(2)(b) Electric Service for Irrigation**

Establishing electric service for irrigation includes installing conduit, conductors, and pull boxes and making connections from the service point to the irrigation controllers.

#### **87-1.03L(2)(c) Electric Service for Booster Pumps**

Establishing electric service for a booster pump includes installing conduit, conductors, and pull boxes and making connections from the service point to the booster pump enclosure.

#### **87-1.03L(3) Telecommunications Service**

Establishing telecommunication service includes installing conduit, conductors, and pull boxes and making connections from the service point to the telephone demarcation cabinet.

#### **87-1.03M Photoelectric Controls**

Mount the photoelectric unit on the top of the pole for Type I, II, and III photoelectric controls. Use mounting brackets where pole-top mounting is not possible. Orient the photoelectric unit to face north.

Mount the enclosure at a height of 6 feet above finished grade on the same standard as the photoelectric unit.

Install a minimum 100 VA, 480/120 V(ac) transformer in the contactor enclosure to provide 120 V(ac) for the photoelectric control unit when switching 480 V(ac), 60 Hz circuits.

#### **87-1.03N Fused Splice Connectors**

Install a fuse splice connector in each ungrounded conductor for luminaires mounted on standards. The connector must be located in the pull box adjacent to the standard.

Crimp the connector terminals onto the ungrounded conductors using a tool under the manufacturer's instructions. Insulate the terminals and make them watertight.

#### **87-1.03O Grounding Electrodes**

Install a grounding electrode for each cabinet, service equipment enclosure, and transformer.

Attach a grounding conductor from the electrode using either a ground clamp or exothermic weld. Connect the other end of the conductor to the cabinet, service equipment enclosure, and transformer.

#### **87-1.03P Service Equipment Enclosures**

Installing a service equipment enclosure includes constructing the foundation and pad and installing conduit, adjacent pull boxes, and grounding electrode.

Locate the foundation such that the minimum clearance around the front and back of the enclosure complies with NEC, article 110.26, "Spaces About Electrical Equipment, (600 V, nominal or less)."

Bond and ground metal conduit as specified in NEC and by the service utility except the grounding electrode conductor must be no. 6 or larger.

If circuit breakers and components do not have a description on engraved phenolic nameplates, install them using stainless steel rivets or screws under section 86-1.02P(2).

#### **87-1.03Q Cabinets**

##### **87-1.03Q(1) General**

Installing a cabinet includes constructing the foundation and pad and installing conduit, adjacent pull boxes, and grounding electrode.

Apply a mastic or caulking compound before installing the cabinet on the foundation to seal the openings.

Connect the field wiring to the terminal blocks in the cabinet. Neatly arrange and lace or enclose the conductors in plastic tubing or raceway. Terminate the conductors with properly sized captive or spring spade terminals. Apply a crimp-style connector and solder them.

Install and solder a spade-type terminal on no. 12 and smaller field conductors and a spade-type or ring-type terminal on conductors larger than no. 12.

#### **87-1.03Q(2) Department-Furnished Controller Cabinets**

Arrange for the delivery of Department-furnished controller cabinets.

#### **87-1.03Q(3) Reserved**

#### **87-1.03Q(4) Telephone Demarcation Cabinets**

Installing a telephone demarcation cabinet includes installing conduit, cable, and pull boxes to the controller cabinet.

Install the cabinet with the back toward the nearest lane of traffic.

#### **87-1.03R Signal Heads**

##### **87-1.03R(1) General**

Installing a signal head includes mounting the heads on standards and mast arms, installing backplates and visors, and wiring conductors to the terminal blocks.

Keep the heads covered or direct them away from traffic until the system is ready for operation.

##### **87-1.03R(2) Signal Faces**

Use the same brand and material for the signal faces at each location.

Program the programmable visibility signal faces under the manufacturer's instructions. The indication must be visible only in those areas or lanes to be controlled.

##### **87-1.03R(3) Backplates**

Install backplates using at least six 10-24 or 10-32 self-tapping and locking stainless steel machine screws and flat washers.

If a plastic backplate requires field assembly, attach each joint using at least four no.10 machine screws. Each machine screw must have an integral or captive flat washer, a hexagonal head slotted for a standard screwdriver, and either a locking nut with an integral or captive flat washer or a nut, flat washer, and lock washer. Machine screws, nuts, and washers must be stainless steel or steel with a zinc or black oxide finish.

If a metal backplate has 2 or more sections, fasten the sections with rivets or aluminum bolts peened after assembly to avoid loosening.

Install the backplate such that the background light is not visible between the backplate and the signal face or between sections.

##### **87-1.03R(4) Signal Mounting Assemblies**

Install a signal mounting assembly such that its members are arranged symmetrically and plumb or level. Orient each mounting assembly to allow maximum horizontal clearance to the adjacent roadway.

For a bracket-mounted assembly, bolt the terminal compartment or pole plate to the pole or standard.

In addition to the terminal compartment mounting, attach the upper pipe fitting of Type SV-1-T with 5 sections or a SV-2-TD to the standard or pole using the mounting detail for signal heads without a terminal compartment.

Use a 4-1/2-inch slip fitter and set screws to mount an assembly on a post top.

After installing the assembly, clean and paint the exposed threads of the galvanized conduit brackets and bracket areas damaged by the wrench or vise jaws. Use a wire brush to clean and apply 2 coats of unthinned, organic zinc-rich primer. Do not use an aerosol can to apply the primer.



Install the conductors in the terminal compartment and secure the cover.

### **87-1.03S Pedestrian Signal Heads**

Installing a pedestrian signal head includes mounting the heads on standards and wiring conductors to the terminal blocks.

Install the pedestrian signal mounting assembly under section 87-1.03R(4).

Use the same brand and material for the pedestrian signal faces at each location.

Install a pedestrian signal face such that its members are arranged symmetrically and plumb or level.

### **87-1.03T Accessible Pedestrian Signals**

Use the same brand for the accessible pedestrian signals at each location.

Install an accessible pedestrian signal and the R10 series sign on the crosswalk side of the standard.

Attach the accessible pedestrian signal to the standard with self-tapping screws.

Attach the sign to the standard using 2 straps and saddle brackets.

Point the arrow on the accessible pedestrian signal in the same direction as the corresponding crosswalk.

Furnish the equipment and hardware to set up and calibrate the accessible pedestrian signal.

Arrange to have a manufacturer's representative at the job site to program the accessible pedestrian signal with an audible message or tone.

### **87-1.03U Push Button Assemblies**

Install the push button assembly and the R10 series sign on the crosswalk side of the standard.

Attach the sign to the assembly for Type B assemblies.

Attach the sign to the standard using 2 straps and saddle brackets for Type C assemblies.

You may use straps and saddle brackets to secure the push button to the standard.

Use a slip fitter to secure the assembly on top of a 2-1/2-inch-diameter post.

### **87-1.03V Detectors**

#### **87-1.03V(1) General**

Installing a detector includes installing inductive loop conductors, sealant, conduit, and pull boxes.

Center the detectors in the traffic lanes.

Do not splice the detector conductor.

#### **87-1.03V(2) Inductive Loop Detectors**

Mark the location of the inductive loop detectors such that the distance between the side of the loop and a lead-in saw cut from an adjacent detector is at least 2 feet. The distance between lead-in saw cuts must be at least 6 inches.

Saw cut the slots under section 13-4.03E(7). The bottoms of the slots must be smooth with no sharp edges. For Type E detector loops, saw the slots such that the sides are vertical.

Wash the slots clean using water and blow dry them with compressed air to remove all moisture and debris.

Identify the start of the conductor.

Waterproof the ends of a Type 2 loop conductor before installing it in the conduit to prevent moisture from entering the cable.

Install the loop conductor in the slots and lead-in saw cuts using a 3/16- to 1/4-inch-thick wood paddle. Hold the conductors in place at the bottom of the slot with wood paddles during placement of the sealant.

Wind adjacent loops on the same sensor unit channel in opposite directions.

Twist the conductors for each loop into a pair consisting of a minimum of 2 turns per foot before placing them in the lead-in saw cut and the conduit leading to the pull box. Do not install more than 2 twisted pairs of conductors per lead-in saw cut.

Provide 5 feet of slack in the pull box.

Test each loop for continuity, circuit resistance, and insulation resistance before filling the slots with sealant.

Remove excess sealant from the adjacent road surface before it sets. Do not use solvents to remove the excess.

Identify the loop conductor pair in the pull box, marking the start with the letter *S* and the end with the letter *F*. Band conductors in pairs by lane in the pull box adjacent to the loops and in the cabinet. Identify each pair with the detector designation and loop number.

Install the conductors in a compacted layer of HMA immediately below the uppermost layer if more than one layer will be placed. Install the loop conductors before placing the uppermost layer of HMA. Fill the slot with a sealant flush to the surface.

Install the conductors in the existing pavement if one layer of HMA is to be placed. Install the loop conductors before placing the layer of HMA. Fill the slot with a sealant flush to the surface.

### **87-1.03V(3) Preformed Inductive Loop Detectors**

Construct a preformed inductive loop detector consisting of 4 turns in the loop and a lead-in conductor pair twisted at least 2 turns per foot all encased in conduit and sealed to prevent water penetration. The detector must be 6-foot square unless shown otherwise.

Construct the loop detector using a minimum 3/8-inch Schedule 40 or Schedule 80 PVC or polypropylene conduit and no. 16 or larger conductor with Type THWN or TFFN insulation.

In new roadways, place the detector in the base course with the top of the conduit flush with the top of the base. Cover with HMA or concrete pavement. Protect the detector from damage before and during pavement placement.

In new reinforced concrete bridge decks, secure the detector to the top of the uppermost layer of reinforcing steel using nylon wire ties. Hold the detector parallel to the bridge deck using PVC or polypropylene spacers where necessary. Place conduit for lead-in conductors between the uppermost 2 layers of reinforcing steel.

Do not install detectors in existing bridge decks unless authorized.

Install a detector in existing pavement before placement of concrete or HMA as follows:

1. Saw cut slots at least 1-1/4 inches wide into the existing pavement.
2. Place the detector in the slots. The top of the conduit must be at least 2 inches below the top of the pavement.
3. Test each loop circuit for continuity, circuit resistance, and insulation resistance.
4. Fill saw cuts with elastomeric or hot melt rubberized asphalt sealant for asphalt concrete pavement and with epoxy sealant or hot melt rubberized asphalt sealant for concrete pavement.

### **87-1.03W Sealants**

#### **87-1.03W(1) General**

Reserved

#### **87-1.03W(2) Elastomeric Sealant**

Apply an elastomeric sealant with a pressure feed applicator.

#### **87-1.03W(3) Asphaltic Emulsion Sealant**

Asphaltic emulsion sealant must:

1. Be used for filling slots in asphalt concrete pavement of a maximum width of 5/8 inch
2. Not be used on concrete pavement or where the slope causes the material to run from the slot
3. Be thinned under the manufacturer's instructions
4. Be placed when the air temperature is at least 45 degrees F

#### **87-1.03W(4) Hot-Melt Rubberized Asphalt Sealant**

Melt the sealant in a jacketed, double-boiler-type, melting unit. The temperature of the heat transfer medium must not exceed 475 degrees F.

Apply the sealant with a pressure feed applicator or a pour pot when the surface temperature of the pavement is greater than 40 degrees F.

#### **87-1.03X Reserved**

#### **87-1.03Y Transformers**

Installing a transformer includes placing the transformer inside a pull box, a cabinet, or an enclosure.

Wire the transformer for the appropriate voltage.

Ground the secondary circuit of the transformer as specified in the NEC.

#### **87-1.03Z Reserved**

#### **87-1.04 PAYMENT**

Not Used

## **87-2 LIGHTING SYSTEMS**

### **87-2.01 GENERAL**

#### **87-2.01A Summary**

Section 87-2 includes specifications for constructing lighting systems.

Lighting system includes:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors
5. Standards
6. Luminaires
7. Service equipment enclosure
8. Photoelectric control
9. Fuse splice connectors
10. High mast lighting assemblies

The components of a lighting system are shown on the project plans.

#### **87-2.01B Definitions**

Reserved

#### **87-2.01C Submittals**

Submit a certificate of compliance and test data for the high mast lighting luminaires.

#### **87-2.01D Quality Assurance**

Reserved

### **87-2.02 MATERIALS**

#### **87-2.02A General**

Reserved

### **87-2.02B High Mast Lighting Assemblies**

A high mast lighting assembly includes the foundation, pole, lowering device system, luminaires, and control pedestal.

Each luminaire in a high mast lighting assembly must include a housing, an optical system, and a ballast.

The housing must be made of aluminum.

A painted or powder-coated housing for a high mast lighting luminaire must be able to withstand a 1,000-hour salt spray test as specified in ASTM B117.

The optical system, consisting of the reflector, refractor or lens, lamp socket, and lamp, must be in a sealed chamber. The chamber must be sealed by a gasket between the reflector and refractor or lens and a gasket between the reflector and lamp socket. The chamber must have a separate filter or filtering gasket for flow of air.

An asymmetrical luminaire must have a refractor or reflector that is rotatable 360 degrees around a vertical axis to orient the distribution of light.

The luminaire must have a slip fitter for mounting on a 2-inch horizontal pipe tenon and must be adjustable  $\pm 3$  degrees from the axis of the tenon.

The reflector must have a specular surface made of silvered glass or aluminum protected by either an anodized finish or a silicate film. The reflector must be shaped such that a minimum of light is reflected through the arc tube of the lamp.

The refractor and lens must be made of heat-resistant glass.

The lamp socket must be a porcelain-enclosed, mogul-multiple type. The shell must contain integral lamp grips to ensure electrical contact under conditions of normal vibrations. The socket must be rated for 1,500 W, 600 V(ac) and 4,000 V(ac) pulse for a 400 W lamp and 5,000 V(ac) pulse for a 1,000 W lamp.

The luminaire must have a dual fuse holder for 2 fuses rated at 5 A, 480 V(ac). The fuses must be 13/32 inch by 1-1/2 inches, standard midjet ferrule type with a nontime-delay feature.

The lamps must be vertical burning, protected from undue vibration, and prevented from backing out of the socket by a stainless steel clamp attached to the luminaire.

A 1,000 W metal halide lamp must have an initial output of 100,000 lumens and an average rated life of 12,000 hours based on 10 hours per start.

A 400 W high-pressure sodium lamp must have an initial output of 50,000 lumens. A 1,000 W high-pressure sodium lamp must have an initial output of 140,000 lumens.

The ballast for the luminaire must be a regulator type and have a core and coils, capacitors, and starting aid.

Ballast must be:

1. Mounted within a weatherproof housing that integrally attaches to the top of a luminaire support bracket and lamp support assembly
2. Readily removable without removing the luminaire from the bracket arm
3. Electrically connected to the optical assembly by a prewired quick disconnect

The ballast for a metal halide luminaire must comply with luminaire manufacturer's specifications.

The wattage regulation spread at any lamp voltage, from nominal through the life of the lamp, must vary no more than 22 percent for a 1,000 W lamp and a  $\pm 10$  percent input voltage variation. The ballast's starting line current must be less than its operating current.

### **87-2.02C Soffit and Wall-Mounted Luminaires**

#### **87-2.02C(1) General**

Soffit and wall-mounted luminaires must be weatherproof and corrosion resistant.

Each luminaire must include a 70 W high-pressure sodium lamp with a minimum average rated life of 24,000 hours. The lamp socket must be positioned such that the light center of the lamp is located within 1/2 inch of the designed light center of the luminaire.

Luminaire wiring must be SFF-2.

Flush-mounted soffit luminaire must have:

1. Metal body with two 1-inch-minimum conduit hubs and a means of anchoring the body into the concrete
2. Prismatic refractor made of heat-resistant polycarbonate:
  - 2.1. Mounted in a door frame
  - 2.2. With the street side identified
3. Aluminum reflector with a specular anodized finish
4. Ballast located either within the housing or in a ceiling pull box if shown
5. Lamp socket

The door frame assembly must be hinged, gasketed, and secured to the luminaire body with at least 3 machine screws.

A pendant soffit luminaire must be enclosed and gasketed and have an aluminum finish. Luminaire must have:

1. Aluminum reflector with a specular anodized finish
2. Refractor made of heat-resistant polycarbonate
3. Optical assembly that is hinged and latched for lamp access and a device to prevent dropping
4. Ballast designed for operation in a raintight enclosure
5. Galvanized metal box with a gasketed cover, 2 captive screws, and 2 chains to prevent dropping and for luminaire mounting

Wall-mounted luminaire must have:

1. Cast metal body
2. Prismatic refractor:
  - 2.1. Made of glass
  - 2.2. Mounted in a door frame
3. Aluminum reflector with a specular anodized finish
4. Integral ballast
5. Lamp socket
6. Gasket between the refractor and the body
7. At least 2 mounting bolts of minimum 5/16-inch diameter

A cast aluminum body of a luminaire to be cast into or mounted against concrete must have a thick coat of alkali-resistant bituminous paint on all surfaces to be in contact with the concrete.

### **87-2.02C(2) High-Pressure Sodium Lamp Ballasts**

#### **87-2.02C(2)(a) General**

A high-pressure sodium lamp ballast must operate the lamp for its rated wattage.

Starting aids for a ballast must be interchangeable between ballasts of the same wattage and manufacturer without adjustment.

The ballast must be provided with a heat-generating component to serve as a heat sink. The capacitor must be placed at the maximum practicable distance from the heat-generating components or thermally shielded to limit the case temperature to 75 degrees C.

The transformer and inductor must be resin impregnated for protection against moisture. Capacitors, except for those in starting aids, must be metal cased and hermetically sealed.

The ballast must have a power factor of 90 percent or greater.

For the nominal input voltage and lamp voltage, the ballast design center must not vary more than 7.5 percent from the rated lamp wattage.

#### **87-2.02C(2)(b) Regulator-Type Ballasts**

A regulator-type ballast must be designed such that a capacitance variance of  $\pm 6$  percent does not cause more than  $\pm 8$  percent variation in the lamp wattage regulation.

The ballast must have a current crest factor not exceeding 1.8 for an input voltage variation of  $\pm 10$  percent.

The lamp wattage regulation spread for a lag-type ballast must not vary by more than 18 percent for  $\pm 10$  percent input voltage variations. The primary and secondary windings must be electrically isolated.

The lamp wattage regulation spread for a constant-wattage, autoregulator, lead-type ballast must not vary by more than 30 percent for  $\pm 10$  percent input voltage variations.

#### **87-2.02C(2)(c) Nonregulator-Type Ballasts**

A nonregulator-type ballast must have a current crest factor not exceeding 1.8 for an input voltage variation of  $\pm 5$  percent.

The lamp wattage regulation spread for an autotransformer or high reactance type ballast must not vary by more than 25 percent for  $\pm 5$  percent input voltage variations.

### **87-2.03 CONSTRUCTION**

#### **87-2.03A General**

Set the foundations for standards such that the mast arm is perpendicular to the centerline of the roadway.

Tighten the cap screws of the luminaire's clamping bracket to 10 ft-lb for LED and low-pressure luminaires.

Label the month and year of the installation inside the luminaire housing's door.

Perform the conductor and operational tests for the system.

#### **87-2.03B High Mast Lighting Assemblies**

Mount and connect the luminaires to the accessory support ring. Aim the asymmetrical luminaire to orient the distribution of light.

#### **87-2.03C Soffit and Wall-Mounted Luminaires**

For a flush-mounted soffit luminaire:

1. Prevent concrete from getting into the housing during pouring of the concrete for the structure
2. Install the luminaire with the axis vertical and the street side of the refractor oriented as indicated
3. Locate the luminaire to provide a minimum 2-foot clearance from the inside surface of the girders and 1-foot clearance from the near face of the diaphragm
4. Install the bridge soffit and ceiling pull box over the same lane

For a pendant soffit luminaire:

1. Cast in place the inserts for the no. 8 pull box during concrete placement for a new structure
2. Drill holes for expansion anchors to support the no. 8 pull box on existing structures
3. Bond the suspension conduit and luminaire to the pull box

For a wall-mounted luminaire, provide:

1. Extension junction box or ring on a new structure
2. 4 external mounting taps on an existing structure

Place the soffits or wall-mounted luminaires in operation as soon as practicable after the falsework has been removed from the structure.

If the Engineer orders soffit or wall-mounted luminaires to be activated before permanent power service is available, installing and removing the temporary power service is change order work.

#### **87-2.04 PAYMENT**

Not Used

### **87-3 SIGN ILLUMINATION SYSTEMS**

#### **87-3.01 GENERAL**

##### **87-3.01A Summary**

Section 87-3 includes specifications for constructing sign illumination systems.

Sign illumination system includes:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors
5. Sign lighting fixtures
6. Enclosure for the disconnect circuit breaker
7. Service equipment enclosure
8. Photoelectric control

The components of a sign illumination system are shown on the project plans.

##### **87-3.01B Definitions**

Reserved

##### **87-3.01C Submittals**

Submit the manufacturer's test data for the induction sign-lighting fixtures.

##### **87-3.01D Quality Assurance**

Reserved

#### **87-3.02 MATERIALS**

An induction sign-lighting fixture must include a housing with a door, reflector, refractor or lens, lamp, socket assembly, power coupler, high-frequency generator, fuse block, and fuses.

The fixture must comply with the isofootcandle curves as shown.

Fixture must weigh no more than 44 lb, be rated for 87 W at 120/240 V(ac), and have a mounting assembly made of one of the following materials:

1. Cast aluminum
2. Hot-dip galvanized steel plate
3. Galvanized steel plate finished with one of the following:
  - 3.1. Polymeric coating
  - 3.2. Same finish used for the housing

Housing must:

1. Be corrosion resistant and suitable for wet locations
2. Be above the top of the mounting rails at a maximum height of 12 inches
3. Have weep holes

Door must:

1. Hold a refractor or lens
2. Open without the use of special tools
3. Have a locking position at 50 degrees minimum from the plane of the door opening
4. Be hinged to the housing on the side of the fixture away from the sign panel
5. Have 2 captive latch bolts or other latching device

When the door is opened, it must lock in the 50 degrees position when an 85 mph, 3-second wind-gust load strikes the door from either side.

The housing and door must be manufactured of sheet or cast aluminum and have a gray powder coat or polyester paint finish. The sheet aluminum must comply with ASTM B209 or B209M for 5052-H32 aluminum sheet. External bolts, screws, hinges, hinge pins, and door closure devices must be corrosion resistant.

The housing and door must be gasketed. The thickness of the gasket must be a minimum of 1/4 inch.

Reflector must not be attached to the outside of the housing and must be:

1. Made of a single piece of aluminum with a specular finish
2. Protected with an electrochemically applied anodized finish or a chemically applied silicate film
3. Designed to drain condensation away from it
4. Secured to the housing with a minimum of 2 screws
5. Removable without removing any fixture parts

Refractor or lens must have a smooth exterior and must be manufactured from the materials shown in the following table:

**Refractor and Lens Material Requirements**

Component	Material
Flat lens	Heat-resistant glass
Convex lens	Heat-resistant, high-impact-resistant tempered glass
Refractor	Borosilicate heat-resistant glass

The refractor and convex lens must be designed or shielded such that no luminance is visible if the fixture is approached directly from the rear and viewed from below. If a shield is used, it must be an integral part of the door casting.

Lamp must:

1. Be an 85 W induction type with a fluorescent, phosphor-coated, interior wall
2. Have a minimum 70 percent light output of its original lumen output after 60,000 hours of operation
3. Have a minimum color-rendering index of 80
4. Be rated at a color temperature of 4,000K
5. Be removable with common hand tools

The lamp socket must be rated for 1,500 W and 600 V(ac) and be a porcelain-enclosed mogul type with a shell that contains integral lamp grips to ensure electrical contact under normal vibration conditions. The shell and center contact must be made of nickel-plated brass. The center contact must be spring loaded.

The power coupler must be removable with common hand tools.

High-frequency generator must:

1. Start and operate lamps at an ambient temperature of -25 degrees C or greater for the rated life of the lamp
2. Operate continuously at ambient air temperatures from -25 to 55 degrees C without a reduction in the generator life
3. Have a design life of at least 100,000 hours at 55 degrees C
4. Have an output frequency of 2.65 MHz  $\pm$  10 percent
5. Have radio frequency interference that complies with 47 CFR 18 regulations regarding harmful interference
6. Have a power factor greater than 90 percent and total harmonic distortion less than 10 percent

The high frequency generator must be mounted such that the fixture can be used as a heat sink and be replaceable with common hand tools.



Each fixture must include a barrier-type fuse block for terminating field connections. Fuse block must:

1. Be rated 600 V(ac)
2. Have box terminals
3. Be secured to the housing and accessible without removal of any fixture parts
4. Be mounted to leave a minimum of 1/2 inch of air space from the sidewalls of the housing
5. Be designed for easy removal of fuses with a fuse puller

The fixture's fuses must be 13/32-inch-diameter, 1-1/2-inch-long ferrule type and UL listed or NRTL certified. For a 120 V(ac) fixture, only the ungrounded conductor must be fused and a solid connection must be provided between the grounded conductor and the high frequency generator.

The fixture must be permanently marked with the manufacturer's brand name, trademark, model number, serial number, and date of manufacture on the inside and outside on the housing. The same information must be marked on the package.

If a wire guard is used, it must be made of a minimum 1/4-inch-diameter galvanized steel wire. The wires must be spaced to prevent rocks larger than 1-1/2-inch diameter from passing through the guard. The guard must be either hot-dip galvanized or electroplated zinc-coated as specified in ASTM B633, service condition SC4, with a clear chromate dip treatment.

### **87-3.03 CONSTRUCTION**

Perform the conductor and operational tests for the system.

### **87-3.04 PAYMENT**

Not Used

## **87-4 SIGNAL AND LIGHTING SYSTEMS**

### **87-4.01 GENERAL**

#### **87-4.01A Summary**

Section 87-4 includes specifications for constructing signal and lighting systems.

Signal and lighting system includes:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors
5. Cables
6. Standards
7. Signal heads
8. Internally illuminated street name signs
9. Service equipment enclosure
10. Department-furnished controller assembly
11. Detectors
12. Telephone demarcation cabinet
13. Accessible pedestrian signals
14. Push button assemblies
15. Pedestrian signal heads
16. Luminaires
17. Photoelectric control
18. Fuse splice connectors
19. Battery backup system
20. Flashing beacons
21. Flashing beacon control assembly

The components of a signal and lighting system are shown on the project plans.

#### **87-4.01B Definitions**

Reserved

### **87-4.01C Submittals**

Submit shop drawings showing the message for each internally illuminated street sign, including the size of letters, symbols, and arrows.

### **87-4.01D Quality Assurance**

#### **87-4.01D(1) General**

Reserved

#### **87-4.01D(2) Quality Control**

##### **87-4.01D(2)(a) General**

Reserved

##### **87-4.01D(2)(b) Battery Backup System**

Notify the Engineer 48 hours before testing the battery backup system.

Test the system in the presence of the Engineer by turning off the power to the signal system at the service equipment enclosure. The signal system must run continuously for 30 minutes. If the battery backup system fails, correct the problem and retest the system for another 30 minutes. After successful completion of the test, turn the power on for the signal system.

### **87-4.02 MATERIALS**

#### **87-4.02A General**

Reserved

#### **87-4.02B Battery Backup System**

A battery backup system includes the cabinet, batteries, and the Department-furnished electronics assembly.

The electronics assembly includes the inverter/charger unit, power transfer relay, and the battery harness.

#### **87-4.02C Internally Illuminated Street Name Signs**

An internally illuminated street name sign includes housing, brackets, sign panels, gaskets, ballast, lampholder, terminal blocks, conductors, and fuses.

An internally illuminated street sign must be designed and constructed to prevent deformation or failure when subjected to an 85 mph, 3-second wind-gust load as specified in the AASHTO publication, "Standard Specifications for Structural Supports of Highway Signs, Luminaires and Traffic Signals."

Sign must:

1. Be Types A or B
2. Have galvanized or cadmium-plated ferrous parts
3. Have screened weep holes
4. Have fasteners, screws, and hardware made of passive stainless steel, Type 302 or 304, or aluminum Type 6060-T6
5. Operate at a temperature from -20 to 74 degrees C

Photoelectric unit sockets are not allowed.

The housing must be constructed to resist torsional twist and warp. The housing must be designed such that opening or removing the panels provides access to the interior of the sign for lamp, ballast, and fuse replacement.

The top and bottom of the sign must be manufactured from formed or extruded aluminum and attached to formed or cast aluminum end fittings. The top, bottom, and end fittings must form a sealed housing.

For a Type A sign, both sides of the sign must be hinged at the top to allow installation or removal of the sign panel.

For a Type B sign, the sign panel must be slide mounted into the housing.

The top of the housing must have 2 free-swinging mounting brackets. Each bracket must be vertically adjustable for leveling the sign to either a straight or curved mast arm. The bracket assembly must allow the lighting fixture to swing perpendicular to the sign panel.

The reflectors must be formed aluminum and have an acrylic, baked-white-enamel surface with a minimum reflectance of 0.85.

Sign panel must be translucent, high-impact-resistant, and made of one of the following plastic materials:

1. Glass-fiber-reinforced, acrylated resin
2. Polycarbonate resin
3. Cellulose acetate butyrate

The sign panel must be designed not to crack or shatter if a 1-inch-diameter steel ball weighing 2.4 ounces is dropped from a height of 8.5 feet above the sign panel to any point on the panel. For this test, the sign panel must be lying in a horizontal position and supported within its frame.

The sign panel's surface must be evenly illuminated. The brightness measurements for the letters must be a minimum of 150 foot-lamberts, average. The letter-to-background brightness ratio must be from 10:1 to 20:1. The background luminance must not vary by more than 40 percent from the average background brightness measurement. The luminance of letters, symbols, and arrows must not vary by more than 20 percent from their average brightness measurement.

The sign panel's white or green color must not fade or darken if exposed to an accelerated test of UV light equivalent to 2 years of outdoor exposure.

The sign panel's legend, symbols, arrows, and border on each face must be white on a green background. The background must comply with color no. 14109 of FED-STD-595.

The message must appear on both sides of the sign and be protected from UV radiation. The letters must be 8-inch upper case and 6-inch lower case, series E.

A Type A sign must have a closed-cell, sponge-neoprene gasket installed between the sign panel frame to prevent the entry of water. The gasket must be uniform and even textured.

The sign ballast must be a high-power-factor type for outdoor operation from 110 to 125 V(ac) and 60 Hz and must comply with ANSI C82.1 and C82.2.

The ballast for a Type A sign must be rated at 200 mA. The ballast for a Type B sign must be rated at 430 mA.

Sign lampholder must:

1. Be the spring-loaded type
2. Have silver-coated contacts and waterproofed entrance leads
3. Have a heat-resistant, circular cross section with a partially recessed neoprene ring

Removal of the lamp from the socket must de-energize the primary of the ballast.

The springs for the lampholders must not be a part of the current-carrying circuit.

The sign's wiring connections must terminate on a molded, phenolic, barrier-type, terminal block rated at 15 A, 1,000 V(ac). The connections must have a white, integral, waterproof marking strip. The terminal screws must not be smaller than a no. 10.

The terminal block must be insulated from the fixture to provide protection from the line-to-ground flashover voltage.

A sectionalized terminal block must have an integral barrier on each side and must allow rigid mounting and alignment.

Fixture's conductors must:

1. Be stranded copper wire with a minimum thermoplastic insulation of 28 mils

2. Be rated at 1,000 V(ac) and for use up to 90 degrees C
3. Be a minimum of no. 16
4. Match the color coding of the ballast leads
5. Be secured with spring cross straps, installed 12 inches apart or less in the chassis or fixture

Stranded copper conductors connected to screw-type terminals must terminate in crimp-type ring connectors.

No splicing is allowed within the fixture.

The sign's fuse must be the Type 3AG, miniature, slow-blow type.

The fuse holder must be a panel-mounting type with a threaded or bayonet knob that grips the fuse tightly for extraction. Each ballast must have a separate fuse.

### **87-4.03 CONSTRUCTION**

#### **87-4.03A General**

Set the foundations for standards such that the mast arm is perpendicular to the centerline of the roadway.

Tighten the cap screws of the luminaire's clamping bracket to 10 ft-lb for LED and low-pressure luminaires.

Label the month and year of the installation inside the luminaire housing's door.

Perform the conductor and operational tests for the system.

#### **87-4.03B Battery Backup System Cabinets**

Install the battery backup system cabinet to the right of the Model 332L cabinet.

If installation on the right side is not feasible, obtain authorization for installation on the left side.

Provide access for power conductors between the cabinets using:

1. 2" nylon-insulated, steel chase nipple
2. 2" steel sealing locknut
3. 2" nylon-insulated, steel bushing

Remove the jumper between the terminals labeled *BBS-1* and *BBS-2* in the 5 position terminal block in the controller cabinet before connecting the Department-furnished electronics assembly.

#### **87-4.03C Internally Illuminated Street Name Signs**

Mount the internally illuminated street name sign to the signal mast arm using the adjustable brackets. Connect the conductors to the terminal blocks in the signal head mounting terminal block.

#### **87-4.04 PAYMENT**

Not Used

## **87-5 RAMP METERING SYSTEMS**

### **87-5.01 GENERAL**

Section 87-5 includes specifications for constructing ramp metering systems.

Ramp metering system includes:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors
5. Standards
6. Signal heads
7. Service equipment enclosure
8. Department-furnished controller assembly

9. Detectors
10. Telephone demarcation cabinet

The components of a ramp metering system are shown on the project plans.

#### **87-5.02 MATERIALS**

Not Used

#### **87-5.03 CONSTRUCTION**

Connect the field wiring to the terminal blocks in the controller cabinet. The Engineer provides you a list of field conductor terminations for each controller cabinet.

Perform the conductor and operational tests for the system.

#### **87-5.04 PAYMENT**

Not Used

### **87-6 TRAFFIC MONITORING STATION SYSTEMS**

#### **87-6.01 GENERAL**

Section 87-6 includes specifications for constructing traffic monitoring station systems.

Traffic monitoring station system includes:

1. Foundations
2. Pull boxes
3. Conduit
4. Cables
5. Conductors
6. Service equipment enclosure
7. Controller cabinet
8. Detectors
9. Telephone demarcation cabinet

The components of a traffic monitoring station system are shown on the project plans.

#### **87-6.02 MATERIALS**

Not Used

#### **87-6.03 CONSTRUCTION**

Connect the field wiring to the terminal blocks in the controller cabinet. The Engineer provides you a list of field conductor terminations for the controller cabinet.

Perform the conductor and operational tests for the system.

#### **87-6.04 PAYMENT**

Not Used

### **87-7 FLASHING BEACON SYSTEMS**

#### **87-7.01 GENERAL**

Section 87-7 includes specifications for constructing flashing beacon systems.

Flashing beacon system includes:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors
5. Standards
6. Service equipment enclosure
7. Signal heads
8. Flashing beacon control assembly

The components of a flashing beacon system are shown on the project plans.

The flash rate for the flashing beacon must comply with chapter 4L, "Flashing Beacons," of the *California MUTCD*.

The flashing beacon must allow alternating flashing wig-wag operation.

The flashing beacon must have a separate flasher unit installed in the flashing beacon control assembly.

#### **87-7.02 MATERIALS**

Flashing beacon control assembly must:

1. Have a NEMA 3R enclosure with a dead front panel and a hasp with a 7/16-inch hole for a padlock. The enclosure must have one of the following finishes:
  - 1.1. Powder coating.
  - 1.2. Hot-dip galvanized coating.
  - 1.3. Factory-applied, rust-resistant prime coat and finish coat.
2. Have barrier-type terminal blocks rated for 25 A, 600 V(ac), made of molded phenolic or nylon material and have plated-brass screw terminals and integral marking strips.
3. Include a solid state flasher complying with section 8 of NEMA standards publication no. TS 1 for 10 A, dual circuits.

#### **87-7.03 CONSTRUCTION**

Perform the conductor and operational tests for the system.

#### **87-7.04 PAYMENT**

Not Used

### **87-8–87-11 RESERVED**

## **87-12 CHANGEABLE MESSAGE SIGN SYSTEMS**

### **87-12.01 GENERAL**

Section 87-12 includes specifications for constructing changeable message sign systems.

Changeable message sign system includes:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors
5. Service equipment enclosure
6. Department-furnished controller cabinet
7. Department-furnished changeable message sign
8. Department-furnished wiring harness
9. Service equipment enclosure
10. Sign disconnect

The components of a changeable message sign system are shown on the project plans.

### **87-12.02 MATERIALS**

Not Used

### **87-12.03 CONSTRUCTION**

Install the changeable message sign.

Connect the field wiring to the terminal blocks in the sign assembly and controller cabinet.

The Engineer provides you a list of field conductor terminations for each sign cabinet and controller cabinet.

The Department maintains the sign assemblies.

#### **87-12.04 PAYMENT**

Not Used

#### **87-13–87-17 RESERVED**

#### **87-18 INTERCONNECTION CONDUIT AND CABLE**

##### **87-18.01 GENERAL**

Section 87-18 includes specifications for constructing interconnection conduit and cable.

Interconnection conduit and cable includes:

1. Pull boxes
2. Conduit
3. Signal interconnect cables

The components of an interconnection conduit and cable are shown.

##### **87-18.02 MATERIALS**

Not Used

##### **87-18.03 CONSTRUCTION**

Test the signal interconnect cable.

Connect the signal interconnect cable to the terminal block in the controller cabinets. The Engineer provides you a list of terminations for each controller cabinet.

##### **87-18.04 PAYMENT**

Not Used

#### **87-19 RESERVED**

#### **87-20 TEMPORARY ELECTRICAL SYSTEMS**

##### **87-20.01 GENERAL**

Section 87-20 includes specifications for providing temporary electrical systems.

Obtain the Department's authorization for the type of temporary electrical system and its installation method.

A temporary system must operate on a continuous, 24-hour basis.

##### **87-20.02 MATERIALS**

###### **87-20.02A General**

Material and equipment may be new or used.

The components of a temporary system are shown on the project plans.

If you use Type UF-B cable, the minimum conductor size must be no. 12.

###### **87-20.02B Temporary Flashing Beacon Systems**

A temporary flashing beacon system consists of a flashing beacon system, wood post, generator, and photovoltaic system.

The system must comply with the specifications for a flashing beacon system in section 87-7, except it may be mounted on a wood post or a trailer.

###### **87-20.02C Temporary Lighting Systems**

A temporary lighting system consists of a lighting system, generator, and wood poles.

The system must comply with the specifications for a lighting system in section 87-2, except it may be mounted on a wood pole or a trailer.

### **87-20.02D Temporary Signal Systems**

A temporary signal system consists of a signal and lighting system, wood poles and posts, and a generator.

System must comply with the specifications for a signal and lighting system in section 87-4, except:

1. Signal heads may be mounted on a wood pole, mast arm, tether wire, or a trailer
2. Flashing beacons may be mounted on a wood post, or a trailer

### **87-20.03 CONSTRUCTION**

#### **87-20.03A General**

Provide electrical and telecommunication services for temporary systems. Do not use existing services unless authorized.

Provide power for the temporary electrical systems under section 12-3.33, except you may use a photovoltaic system for the temporary flashing beacon system.

Install conductors and cables in a conduit, suspended from wood poles at least 25 feet above the roadway, or use direct burial conductors and cables.

You may saw slots across paved areas for burial conductors and cables.

Install conduit outside the paved area at a minimum of 12 inches below grade for Type 1 and 2 conduit and at a minimum of 18 inches below grade for Type 3 conduit.

Install direct burial conductors and cables outside the paved area at a minimum depth of 24 inches below grade.

Place the portions of the conductors installed on the face of wood poles in either Type 1, 2, or 3 conduit between the point 10 feet above grade at the pole and the pull box. The conduit between the pole and the pull box must be buried at a depth of at least 18 inches below grade.

Place conductors across structures in a Type 1, 2, or 3 conduit. Attach the conduit to the outside face of the railing.

Mount the photoelectric unit at the top of the standard or wood post.

You may abandon in place conductors and cables in sawed slots or in conduit installed below the ground surface.

#### **87-20.03B Temporary Flashing Beacon Systems**

Install a fused-splice connector in the pull box adjacent to each flashing beacon. Wherever conductors are run overhead, install the splice connector in the line side outside of the control assembly.

#### **87-20.03C Temporary Lighting Systems**

Wherever conductors are run overhead, install the fuse splice connectors in the line side before entering the mast arm.

#### **87-20.03D Temporary Signal Systems**

You may splice conductors that run to a terminal compartment or a signal head on a pole to the through conductors of the same phase in a pull box adjacent to the pole. Do not splice conductors or cables except in a pull box or in a NEMA 3R enclosure.

The Department provides the timing for the temporary signal.

Maintain the temporary signal except for the Department-furnished controller assembly.

### **87-20.04 PAYMENT**

Not Used



## **87-21 EXISTING ELECTRICAL SYSTEMS**

### **87-21.01 GENERAL**

Section 87-21 includes general specifications for performing work on existing electrical systems.

### **87-21.02 MATERIALS**

Not Used

### **87-21.03 CONSTRUCTION**

#### **87-21.03A General**

You may abandon unused underground conduit after pulling out all conductors and removing conduit terminations from the pull boxes.

If standards are to be salvaged, remove:

1. All components
2. Mast arms from the standards
3. Luminaires, signal heads, and signal mounting assemblies from the standards and mast arms

If the existing material is unsatisfactory for reuse and the Engineer orders you to replace it with new material, replacing the existing material with new material is change order work.

If the removed electrical equipment is to be reinstalled, supply all materials and equipment, including signal mounting assemblies, anchor bolts, nuts, washers, and concrete, needed to complete the new installation.

#### **87-21.03B Maintaining Existing Electrical Systems**

##### **87-21.03B(1) General**

Maintain the existing electrical system in working order during the progress of the work. Conduct your operations to avoid damage to the elements of the systems.

##### **87-21.03B(2) Maintaining Existing Traffic Management System Elements During Construction**

Section 87-21.02B(2) applies if a bid item for maintaining existing traffic management system elements during construction is shown on the Bid Item List.

Traffic management system elements include:

1. Ramp metering system
2. Traffic monitoring stations
3. Microwave vehicle detection system
4. Changeable message sign system
5. Extinguishable message sign system
6. Highway advisory radio system
7. Closed circuit television camera system
8. Roadway weather information system

Obtain authorization at least 72 hours before interrupting communication between an existing system and the traffic management center.

If the Engineer notifies you that an existing system is not fully operational due to your activities, repair or replace the system within 72 hours. If the system cannot be fixed within 72 hours or it is located on a structure, provide a temporary system within 24 hours until the system can be fixed. Perform a functional test of the system in the presence of the Engineer. If you fail to perform the necessary repair or replacement work, the Department may perform the repair or replacement work and deduct the cost.

If you damage an existing fiber optic cable, install a new cable such that the length of cable slack is the same as before the damage, measured from an original splice point or termination. All splices must be made using the fusion method.

You may interrupt the operation of traffic monitoring stations:

1. For 60 days if another operational traffic monitoring station is located within 3 miles



For volumetric proportioning of RPC:

1. The volumetric container must be imprinted with manufacturer's name, model number, serial number, the as-calibrated volume and date of the last calibration. Cross sectional dimensions of the container must remain the same as those during its calibration.
2. The device must be re-calibrated monthly and at any time when the container shape has been deformed from its original condition or there is evidence of material build-up on the inside of the device.
3. The device must be held in a level condition during filling. Fill the device to the measure or strike-off line. Each measurement must be filled to within 1.0% of the device as-calibrated volume.
4. The device interior must be cleaned after each measurement to maintain a zero condition.

For weight proportioning, proportion RPC with a weigh hopper attached to the plant at a position which allows the addition of the RPC to the mixer truck with the conventional PCC ingredients. The plant process controller must control the proportioning of RPC to within 1.0% of its target weight.

## **90-9.02 MATERIALS**

### **90-9.02A General**

The quantity of RPC added to the concrete must not exceed 15 percent.

The cementitious material content of the RPC must be at least that specified for the concrete that allows the use of RPC.

Water must not be added to the RPC after batching, including in the truck mixer.

Use HSA for controlling and reducing the hydration rate of RPC.

Incorporate RPC by mixing into the concrete before arriving at the jobsite.

### **90-9.02B Returned Plastic Concrete**

The RPC must not exceed 100 degrees F at any time.

If HSA is not used, RPC must be incorporated into the concrete before attaining initial set or within 4 hours after batching of RPC, whichever is earlier.

If HSA is used:

1. Add HSA to RPC within 4 hours after original batching.
2. Measure and record the time, dosage of HSA, and temperature of RPC when HSA is added.
3. Mix the RPC under the HSA manufacturer's instructions after adding HSA or at least 30 revolutions, whichever is greater.
4. Incorporate RPC into the concrete within 4 hours after adding HSA.

RPC must not contain:

1. Accelerating admixture
2. Fiber
3. Pigment
4. Lightweight aggregate
5. Previously returned RPC
6. Any ingredient incompatible with the resultant concrete

### **90-9.02C Hydration Stabilizing Admixture**

HSA must comply with ASTM C494 admixture Type B or Type D.

HSA must have a proven history of specifically maintaining and extending both plasticity and set.

HSA dosage must comply with the manufacturer's instructions.

### **90-9.02D Production**

Proportion concrete containing RPC under section 90-2.02E.



# BID BOOK

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**CSA 30 & 32 WELL SITE IMPROVEMENTS AND MANGANESE TREATMENT**

**COUNTY SERVICE AREAS 30 & 32 EL PORVENIR & CANTUA CREEK  
COUNTY OF FRESNO WESTSIDE GROUNDWATER PROJECT**

**STATE WATER RESOURCES CONTROL BOARD PROJECT NUMBER: 1000359-005C**

**BUDGET / ACCOUNT: 9172 / 8400 / 91317**



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*Department of Public Works and Planning*

**CONTRACT NUMBER 23-13-C**

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## CSA 30 & 32 WELL SITE IMPROVEMENTS AND MANGANESE TREATMENT CONTRACT NUMBER 23-13-C

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# INSTRUCTIONS FOR COMPLETING THE BID BOOK FOR FEDERAL AID PROJECTS

## General

Complete forms in the *Bid* book.

Submit an electronic bid online at <http://www.BidExpress.com> (Section 2-1.33D) or submit a hardcopy bid:

1. Under sealed cover addressed to the Department and labeled with the name of the bidder, the name of the project and the statement 'Do Not Open Until The Time Of Bid Opening.'
2. Marked as a bid
3. Identifying the contract number and the bid opening date

Certain bid forms must be submitted with the bid and properly executed.

Certain other forms and information must be submitted either with the bid or within the prescribed period after bid opening as specified elsewhere in these special provisions.

Failure to submit the forms and information as specified results in a nonresponsive bid.

If an agent other than the authorized corporation officer or a partnership member signs the bid, file a Power of Attorney with the Department either before opening bids or with the bid. Otherwise, the bid may be nonresponsive.

## Bid Item List and Bid Comparison

Submit a bid based on the bid item quantities the Department shows on the Bid Item List. Bids will be evaluated and the low bidder determined as indicated in the *Notice to Bidders*.

## Bid Document Completion

Proposal items are identified by title and by the word "Proposal" followed by the number assigned to the proposal item in question. Proposal items are included in the *Bid Book*.

## Proposal to the Board of Supervisors of Fresno County – Proposal 1

Provided for information.

## Bid Proposal Sheet – Proposal 2

One or more sheet(s) or list(s) upon which the bidder completes the bid.

Fill out completely including a unit price and total for each unit price-based item and a total for each lump sum item.

Do not make any additions such as "plus tax", "plus freight", or conditions such as "less 2% if paid by 15th".

Use ink or typewriter for paper bids.

## Evaluation of Bid Proposal Sheet – Proposal 3

Describes how inconsistencies and irregularities are evaluated and corrected when Design Services reviews the Bid Item List.

## **Bid Security and Signature – Proposal 4**

Submit one of the following forms of bidder's security equal to at least 10 percent of the bid:

- Cash
- Cashier's check
- Certified check
- Signed bidder's bond by an admitted surety insurer

Indicate type of bid security provided.

- Cash – Acceptable but not recommended. Cash is deposited in a clearing account and is returned to bidders by County warrant. This process may take several weeks.
- Cashier's or Certified Checks. This type of security is held until the bid is no longer under consideration. If submitted by a potential awardee, they will be returned when the contract is fully executed by the bidder and bonds and insurance have been approved.
- Bid Bonds - Must be signed by the bidder and by the attorney-in-fact for the bonding company. Provide notarized signature of attorney-in-fact accompanied by bonding company's affidavit authorizing attorney-in-fact to execute bonds. An unsigned bid bond will be cause for rejection.

Acknowledge Addenda

Provide contractor's license information.

State business name and if business is a:

- Corporation - list officers
- Partnership - list partners
- Joint Venture - list members; if members are corporations or partnerships, list their officers or partners.
- Individual - list Owner's name and firm name style

Signature of Bidder - the following lists types of companies and corresponding authorized signers.

- Corporation - by an officer
- Partnership - by a partner
- Joint Venture - by a member
- Individual - by the Owner

If signature is by a Branch Manager, Estimator, Agent, etc., the bid must be accompanied by a power of attorney authorizing the individual to sign the bid in question or to sign bids more generally, otherwise the bid may be rejected.

- Business Address - Firm's Street Address
- Mailing Address - P.O. Box or Street Address
- Complete, sign, and return with bid.

## **Noncollusion Declaration – Proposal 5**

Must be completed, signed, and returned with bid.

## **Public Contract Code Section 10285.1 Statement – Proposal 6**

Select "has" or "has not" in accordance with instructions on form, return with completed for with bid. Note that signing the bid constitutes signing this statement.



**Public Contract Code Section 10162 Questionnaire And Public Contract Code 10232 Statement – Proposal 7**

Select “yes” or “no” accordance with instructions on form, include explanation if “yes” is selected. Return completed form with bid. Note that signing the bid constitutes signing this questionnaire and statement.

**Subcontractors – Proposal 8(a) through Proposal 8(e)**

Sheet(s) or spaces where upon which bidders list subcontractors. List each subcontractor to perform work in an amount in excess of 1/2 of 1 percent of the total bid or \$10,000, whichever is greater (Pub Cont Code § 4100 et seq.).

The *Subcontractor List* submitted with the bid must show the name, location of business, work portions to be performed, and the contractor’s license number for each subcontractor listed.

- Use subcontractor's business name style as registered with the License Board.
- Specify the city in which the subcontractor’s business is located and the state if other than California.
- Description of the work to be performed by the subcontractor. Indicate with bid item numbers from the bid item list and/or work descriptions similar to those on bid item list.
- List license number for each subcontractor.

Upon request from Design Services, provide the following additional information within 24 hours of bid opening if not included on the *Subcontractor List* submitted with the bid:

- Complete physical address for each subcontractor listed.
- Percentage of the total bid or dollar amount associated with each subcontractor listed.
- Department of Industrial Relations registration number

**Certification With Regard To The Performance Of Previous Contracts Or Subcontracts Subject To The Equal Opportunity Clause And The Filing Of Required Reports – Proposal 9**

Complete, sign, and return with bid. Certification of proposed subcontractors is the responsibility of the Bidder and must be provided to the County upon request.

**Certification Regarding Debarment, Suspension, and Other Responsibility Matters – Proposal 10**

Complete, sign, and return with bid.

**Non-lobbying Certification for Federal-Aid Contracts – Proposal 11**

Complete, sign, and return with bid.

**Disclosure of Lobbying Activities – Proposal 12(a) through Proposal 12(b)**

Complete, sign, and return with bid.

**DBE Information – Good Faith Efforts – Proposal 13**

Complete and return with bid.

**Guidelines for meeting the California state revolving fund programs Disadvantaged Business Enterprise Requirements – Proposal 14**

Complete, sign, and return with bid.

**Guaranty – Proposal 15**

Does not need to be signed with the bid. Part of the contract which must be signed by the contractor when contract is executed.

# **PROPOSAL TO THE BOARD OF SUPERVISORS OF THE COUNTY OF FRESNO**

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hereinafter called the Owner

## **CSA 30 & 32 WELL SITE IMPROVEMENTS AND MANGANESE TREATMENT**

### **COUNTY SERVICE AREAS 30 & 32 EL PORVENIR & CANTUA CREEK COUNTY OF FRESNO WESTSIDE GROUNDWATER PROJECT**

**STATE WATER RESOURCES CONTROL BOARD PROJECT NUMBER: 1000359-005C**

The work embraced herein shall be done in accordance with the 2015 Standard Specifications and with the 2015 Standard Plans, of the State of California, Department of Transportation insofar as the same may apply and in accordance with these special provisions.

Except to the extent that they may conflict with these special provisions, revised Standard Specifications apply to the extent included in the section entitled "Project Details" of the book entitled "Specifications."

The work to be done is shown on a set of Plans, Department File No.11312, entitled: "County Service Areas 30 & 32, El Porvenir & Cantua Creek, County of Fresno Westside Groundwater Project Well Site Improvements & Manganese Treatment"

The undersigned, as bidder, declares that the only persons, or parties interested in this proposal as principals are those named herein, that this proposal is made without collusion with any other person, firm or corporation; that they have carefully examined the location of the proposed work, the annexed proposed form of contract, and the plans therein referred to; and they propose and agrees if this proposal is accepted, that they will contract with the Owner to provide all necessary machinery, tools, apparatus and other means of construction, and to do all the work and furnish all the materials specified in the contract in the manner and time therein prescribed, and according to the requirements of the Engineer as therein set forth, and that they will take in full payment therefor the following unit prices, to-wit:

# Fresno County Department of Public Works and Planning

## Bid Item List - Proposal 2

Contract #

23-13-C

Contract Name

CSA 30 & 32 Well Site Improvements and Manganese Treatment

Location

County Service Areas 30 & 32 El Porvenir and Cantua Creek

### CSA 30 - EL PORVENIR

Item ID	Quantity	Unit	Unit Price	Total
Description				
1	1	LS	\$	\$
Mobilization, Insurance, and Bonds				
2	1	EA	\$	\$
Construction Project Information Sign				
3	1	LS	\$	\$
Job Site Management				
4	1	LS	\$	\$
Prepare and Implement Storm Water Pollution Prevention Plan				
5	1	LS	\$	\$
Dust Control				
6	1	LS	\$	\$
Traffic Control				
7	1	LS	\$	\$
Clearing and Grubbing				
8	1	LS	\$	\$
Site Grading				

9	1	LS	\$		\$	
Site Piping, Valves, and Appurtenances						
10	1	LS	\$		\$	
Class 2 Aggregate Base Surfacing						
11	1	LS	\$		\$	
Chain Link Fence and Access Gates						
12	1	LS	\$		\$	
Site Electrical, Controls and Lighting						
13	1	LS	\$		\$	
Standby Generator & Appurtenances						
14	1	LS	\$		\$	
Manganese Treatment Unit & Concrete Pad						
15	1	LS	\$		\$	
Hydropneumatic Tank						
16	1	LS	\$		\$	
Booster Pump Station						
17	1	LS	\$		\$	
Chlorination Building and Enclosure						
18	1	EA	\$		\$	
Tie-in to Existing Water System						
19	235	LF	\$		\$	
Temporary Trench Resurfacing						
20	235	LF	\$		\$	
Permanent Trench Resurfacing						
21	1	LS	\$		\$	
Demolish Existing Phase 1 Site Improvements						

22	1	LS	\$	\$
Demolish Existing Phase 2 Site Improvements				
23	1	LS	\$	\$
Operations Building				
24	4	EA	\$	\$
48" Sanitary Sewer Manhole				
25	1	LS	\$	\$
Drive Approaches				
26	1	LS	\$	\$
Accessible Parking and Concrete Walkway				
27	1	LS	\$	\$
Destroy Existing CSA 30 Well				
28	1	LS	\$	\$
Startup and Testing				
29	1	LS	\$	\$
Operation and Maintenance Manuals				
30	1	LS	\$	\$
Record Drawings				

CSA 30 Bid Items Total (Items 1 through 30): \$

**CSA 32 - CANTUA CREEK**

Item ID Description	Quantity	Unit	Unit Price	Total
31 Mobilization, Insurance, and Bonds	1	LS	\$	\$
32 Construction Project Information Sign	1	EA	\$	\$
33 Job Site Management	1	EA	\$	\$
34 Prepare and Implement Storm Water Pollution Prevention Plan	1	LS		
35 State Water Resources Control Board - Notice of Intent	500	\$	\$1	\$500
36 Dust Control	1	LS	\$	\$
37 Traffic Control	1	LS	\$	\$
38 Clearing and Grubbing	1	LS	\$	\$
39 Site Grading	1	LS	\$	\$
40 Site Piping, Valves, and Appurtenances	1	LS	\$	\$
41 Class 2 Aggregate Base Surfacing	1	LS	\$	\$

42	1	LS	\$		\$	
Chain Link Fence and Access Gates						
43	1	LS	\$		\$	
Control Enclosure						
44	1	LS	\$		\$	
Site Electrical, Controls and Lighting						
45	1	LS	\$		\$	
Standby Generator & Appurtenances						
46	1	LS	\$		\$	
Manganese Treatment Unit & Concrete Pad						
47	1	LS	\$		\$	
Hydropneumatic Tank						
48	1	LS	\$		\$	
Booster Pump Station						
49	1	LS	\$		\$	
Chlorination Building and Enclosure						
50	2	EA	\$		\$	
Tie-in to Existing Water System						
51	1	LS	\$		\$	
Demolish Existing Phase 1 Site Improvements						
52	1	LS	\$		\$	
Demolish Existing Phase 2 Site Improvements						
53	1	LS	\$		\$	
Drive Approaches						

54	1	LS	\$	
Destroy Existing CSA 32 Well				
55	1	LS	\$	
Storm Drain Access Ramp				
56	1	LS	\$	
Startup and Testing				
57	1	LS	\$	
Operation and Maintenance Manuals				
58	1	LS	\$	
Record Drawings				
59	150000	\$	\$1	\$150,000
Supplemental Work				
CSA 32 Bid Items Total (Items 31 through 59):				\$
Total Bid: Items 1 through 59:				\$



## EVALUATION OF BID PROPOSAL ITEM LIST

Abbreviations used in the bid proposal sheet are identified in Section 1-1.06, "Abbreviations," of these special provisions.

Bids are required for the entire work. Bids will be compared on the basis indicated in the Notice to Bidders. The bidder shall set forth for each unit basis item of work a unit price and a total for the item, and for each lump sum item a total for the item, all in clearly legible figures in the respective spaces provided for that purpose. In the case of unit basis items, the amount set forth under the "Item Total" column shall be the product of the unit price bid and the estimated quantity for the item.

In case of discrepancy between the unit price and the total set forth for a unit basis item, the unit price shall prevail, except as provided in (a) or (b), as follows:

- (a) If the amount set forth as a unit price is unreadable or otherwise unclear, or is omitted, or is the same as the amount as the entry in the item total column, then the amount set forth in the item total column for the item shall prevail and shall be divided by the estimated quantity for the item and the price thus obtained shall be the unit price;
- (b) (Decimal Errors) If the product of the entered unit price and the estimated quantity is exactly off by a factor of ten, one hundred, etc., or one-tenth, or one-hundredth, etc. from the entered total, the discrepancy will be resolved by using the entered unit price or item total, whichever most closely approximates percentage-wise the unit price or item total in the Owner's Final Estimate of cost.

If both the unit price and the item total are unreadable or otherwise unclear, or are omitted, the bid may be deemed irregular. Likewise, if the item total for a lump sum item is unreadable or otherwise unclear, or is omitted, the bid may be deemed irregular unless the project being bid has only a single item and a clear, readable total bid is provided.

Symbols such as commas and dollar signs will be ignored and have no mathematical significance in establishing any unit price or item total or lump sums. Written unit prices, item totals and lump sums will be interpreted according to the number of digits and, if applicable, decimal placement. Cents symbols also have no significance in establishing any unit price or item total since all figures are assumed to be expressed in dollars and/or decimal fractions of a dollar. Bids on lump sum items shall be item totals only; if any unit price for a lump sum item is included in a bid and it differs from the item total, the items total shall prevail.

The foregoing provisions for the resolution of specific irregularities cannot be so comprehensive as to cover every omission, inconsistency, error or other irregularity which may occur in a bid. Any situation not specifically provided for will be determined in the discretion of the Owner, and that discretion will be exercised in the manner deemed by the Owner to best protect the public interest in the prompt and economical completion of the work. The decision of the Owner respecting the amount of a bid, or the existence or treatment of an irregularity in a bid, shall be final.

If this proposal shall be accepted and the undersigned shall fail to contract, as aforesaid, and to give the two bonds in the sums to be determined as aforesaid, with surety satisfactory to the Owner, within eight (8) days not including Saturdays, Sundays and legal holidays, after the bidder has received notice of award of the contract, the Owner, at its option, may determine that the bidder has abandoned the contract, and thereupon this proposal and the acceptance thereof shall be null and void, and the forfeiture of such security accompanying this proposal shall operate and the same shall be the property of the Owner.

**Bid Security**

Accompanying this proposal is security (check one only) in amount equal to at least ten percent (10%) of the total amount of the bid:

Bid Bond ( ) ; Certified Check ( ) ; Cashier's Check ( ) ; Cash (\$ )

**Addenda Acknowledgement**

Bidder has and acknowledges the following addenda: \_\_\_\_\_

**Bidder Signature**

Business Name \_\_\_\_\_

*Note: If bidder or other interested person is a corporation, state legal name of corporation. If bidder is a co-partnership, state true name of firm.*

Business Owners and Officers Names \_\_\_\_\_

*Note: If bidder or other interested person is:*

- a corporation, list names of the president, secretary, treasurer and manager thereof
- a partnership, list names of all individual co-partners composing firm.
- an individual, state first and last name in full.

Names of Owners and Key Employees \_\_\_\_\_

*Note: List majority owners of your firm. If multiple owners, list all. Also include anyone, including key employees, who are actively promoting the contract. (SB1439)*

Licensed in accordance with an act providing for the registration of Contractors:

Class \_\_\_\_\_ Contractor License No. \_\_\_\_\_ Expires \_\_\_\_\_

DIR Registration Number \_\_\_\_\_

Business Address: \_\_\_\_\_ Zip Code \_\_\_\_\_

Mailing Address: \_\_\_\_\_ Zip Code \_\_\_\_\_

Business Phone: (\_\_\_\_\_) \_\_\_\_\_ Fax Number: (\_\_\_\_\_) \_\_\_\_\_

Email Address \_\_\_\_\_

Signature of Bidder: \_\_\_\_\_ Dated: \_\_\_\_\_

NOTE: If bidder is a corporation, the legal name of the corporation shall be set forth above together with the signature of the officer or officers authorized to sign contracts on behalf of the corporation; if bidder is a co-partnership, the true name of the firm shall be set forth above together with the signature of the partner or partners authorized to sign contracts on behalf of the co-partnership; and if bidder is an individual, his or her signature shall be placed above. If signature is by an agent, other than an officer of a corporation or a member of a partnership, a Power of Attorney must be on file with the Owner prior to opening bids or submitted with the bid; otherwise, the bid will be disregarded as irregular and unauthorized.

**State Water Resources Control Board Project Number: 1000359-005c**

To the County of Fresno:

**NONCOLLUSION DECLARATION**

TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID\*

The undersigned declares:

I am the \_\_\_\_\_ of  
(Owner, Partner, Corporate Officer (list title), Co-Venturer)

\_\_\_\_\_, the party making the foregoing bid.

The bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation. The bid is genuine and not collusive or sham. The bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid. The bidder has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or refrain from bidding. The bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder. All statements contained in the bid are true. The bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof, and has not paid, and will not pay, any person or entity for that purpose.

Any person executing this declaration on behalf of a bidder that is a corporation, partnership, joint venture, limited liability company, limited liability partnership, or any other entity, hereby represents that he or she has full power to execute, and does execute, this declaration on behalf of the bidder.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct and that this declaration is executed on \_\_\_\_\_, 2023,

at \_\_\_\_\_,"  
[city] [state]

\_\_\_\_\_  
(Signature)

(See Title 23 United States Code Section 112; Calif Public Contract Code Section 7106)

\*NOTE: Completing, signing, and returning the Non-Collusion Declaration is a required part of the Proposal. Bidders are cautioned that making a false certification may subject the certifier to criminal prosecution.

## **PUBLIC CONTRACT CODE**

### **Public Contract Code Section 10285.1 Statement**

In conformance with Public Contract Code Section 10285.1 (Chapter 376, Stats. 1985), the bidder hereby declares under penalty of perjury under the laws of the State of California that the bidder has \_\_\_\_, has not \_\_\_\_been convicted within the preceding three years of any offenses referred to in that section, including any charge of fraud, bribery, collusion, conspiracy, or any other act in violation of any state or Federal antitrust law in connection with the bidding upon, award of, or performance of, any public works contract, as defined in Public Contract Code Section 1101, with any public entity, as defined in Public Contract Code Section 1100, including the Regents of the University of California or the Trustees of the California State University. The term "bidder" is understood to include any partner, member, officer, director, responsible managing officer, or responsible managing employee thereof, as referred to in Section 10285.1.

Note: The bidder must place a check mark after "has" or "has not" in one of the blank spaces provided. The above Statement is part of the Bid. Signing this Bid on the signature portion thereof shall also constitute signature of this Statement. Bidders are cautioned that making a false certification may subject the certifier to criminal prosecution.

**Public Contract Code Section 10162 Questionnaire**

In conformance with Public Contract Code Section 10162, the Bidder shall complete, under penalty of perjury, the following questionnaire:

Has the bidder, any officer of the bidder, or any employee of the bidder who has a proprietary interest in the bidder, ever been disqualified, removed, or otherwise prevented from bidding on, or completing a federal, state, or local government project because of a violation of law or a safety regulation?

Yes \_\_\_\_\_ No \_\_\_\_\_

If the answer is yes, explain the circumstances in the following space.

**Public Contract Code 10232 Statement**

In conformance with Public Contract Code Section 10232, the Contractor, hereby states under penalty of perjury, that no more than one final unappealable finding of contempt of court by a federal court has been issued against the Contractor within the immediately preceding two-year period because of the Contractor's failure to comply with an order of a federal court which orders the Contractor to comply with an order of the National Labor Relations Board.

Note: The above Statement and Questionnaire are part of the Bid. Signing this Bid on the signature portion thereof shall also constitute signature of this Statement and Questionnaire.

Bidders are cautioned that making a false certification may subject the certifier to criminal prosecution.

**BIDDER:** \_\_\_\_\_

**SUBCONTRACTORS:**

The following named subcontractor(s) will perform with labor, or otherwise render services to the general contractor in or about the construction of the work or improvement in an amount in excess of one-half of one percent of the total bid presented herewith. Each listed subcontractor's name, location of business and description of work, and both their contractor's license number and public works contractor registration number, issued pursuant to Section 1725.5 of the Labor Code, are **REQUIRED**, by Section 4104 of the California Public Contract Code, to be submitted prior to bid opening. (The "location of business" must specify the city in which the subcontractor's business is located, and the state if other than California.) All other requested information shall be submitted, either with the bid or within 24 hours after bid opening.

Please fill out as completely as possible when submitting your bid. Use subcontractor's business name style as registered with the License Board.

**FAILURE TO LIST SUBCONTRACTORS AS DIRECTED MAY RENDER THE BID NON-RESPONSIVE, OR MAY RESULT IN ASSESSMENT OF A PENALTY AGAINST THE BIDDER IN ACCORDANCE WITH SECTION 4110 OF THE CALIFORNIA PUBLIC CONTRACT CODE.**

<p><b>SUBCONTRACTOR:</b> _____</p> <p>Business Address: _____</p> <p>Class ____ License No. _____ DIR Registration No. _____</p> <p>Item No. or Description of Work: _____</p> <p>Dollar Amount _____ <b>OR</b> Percentage of Total Bid _____</p> <p>Email Address: _____</p>
<p><b>SUBCONTRACTOR:</b> _____</p> <p>Business Address: _____</p> <p>Class ____ License No. _____ DIR Registration No. _____</p> <p>Item No. or Description of Work: _____</p> <p>Dollar Amount _____ <b>OR</b> Percentage of Total Bid _____</p> <p>Email Address: _____</p>

**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_

**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No. \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_

**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_

**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No. \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_

**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_

**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_

**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No. \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_

**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_

**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No. \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_

**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_



**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_

**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No. \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_

**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_

**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No. \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_

**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_

**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No. \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_

**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No. \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_

**SUBCONTRACTOR:** \_\_\_\_\_  
Business Address: \_\_\_\_\_  
Class \_\_\_\_ License No. \_\_\_\_\_ DIR Registration No. \_\_\_\_\_  
Item No. or Description of Work: \_\_\_\_\_  
Dollar Amount \_\_\_\_\_ **OR** Percentage of Total Bid \_\_\_\_\_  
Email Address: \_\_\_\_\_

**CERTIFICATION WITH REGARD TO THE PERFORMANCE OF PREVIOUS CONTRACTS OR SUBCONTRACTS SUBJECT TO THE EQUAL OPPORTUNITY CLAUSE AND THE FILING OF REQUIRED REPORTS.**

The bidder or proposed subcontractor hereby certifies that they have \_\_, have not \_\_, participated in a previous contract or subcontract subject to the equal opportunity clause, as required by Executive Orders 10925, 11114, or 11246, and that they have \_\_, have not \_\_, filed with the Joint Reporting Committee, the Director of the Office of Federal Contract Compliance, a Federal Government contracting or administering agency, or the former President's Committee on Equal Employment Opportunity, all reports due under the applicable filing requirements.

\_\_\_\_\_  
(Company)

By: \_\_\_\_\_

\_\_\_\_\_  
(Title)

Date: \_\_\_\_\_

**NOTE:** The above certification is required by the Equal Employment Opportunity Regulations of the Secretary of Labor (41 CFR 60-1.7(b) (1)), and must be submitted by bidders and proposed subcontractors only in connection with contracts and subcontracts which are subject to the equal opportunity clause. Contracts and subcontracts which are exempt from the equal opportunity clause are set forth in 41 CFR 60-1.5. (Generally only contracts or subcontracts of \$10,000 or under are exempt.)

Currently, Standard Form 100 (EEO-1) is the only report required by the Executive Orders or their implementing regulations.

Proposed prime contractors and subcontractors who have participated in a previous contract or subcontract subject to the Executive Orders and have not filed the required reports should note that 41 CFR 60-1.7(b) (1) prevents the award of contracts and subcontracts unless such contractor submits a report covering the delinquent period or such other period specified by the Director, Office of Federal Contract Compliance, U. S. Department of Labor.

**Proposal 9  
Contract Number 23-13-C**

**TITLE 40, CODE OF FEDERAL REGULATIONS, PART 32  
DEBARMENT AND SUSPENSION CERTIFICATION**

**Certification Regarding  
Debarment, Suspension, and Other Responsibility Matters**

**STATE WATER RESOURCES CONTROL BOARD PROJECT NUMBER: 1000359-005C**

The prospective participant certifies to the best of its knowledge and belief that it and its principals:

1. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
2. Have not within a three year period preceding this proposal been convicted of or had a civil judgement rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, falsification or destruction of records, making false statements, or receiving stolen property;
3. Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and
4. Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

**I understand that a false statement on this certification may be grounds for rejection of this proposal or termination of the award. In addition, under 18 USC Sec. 1001, a false statement may result in a fine of up to \$10,000 or imprisonment for up to 5 years, or both.**

---

Name & Title of Authorized Representative Date

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Signature of Authorized Representative

I am unable to certify to the above statements. My explanation is attached.

**Proposal 10  
Contract Number 23-13-C**

## NONLOBBYING CERTIFICATION FOR FEDERAL-AID CONTRACTS

The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

- (1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with awarding of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- (2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

The prospective participant also agrees by submitting his or her bid or proposal that he or she shall require that the language of this certification be included in all lower tier subcontracts, which exceed \$100,000 and that all such sub-recipients shall certify and disclose accordingly.

Bidder: \_\_\_\_\_

By: \_\_\_\_\_

Date: \_\_\_\_\_

Title: \_\_\_\_\_

**Proposal 11**  
**Contract Number 23-13-C**



## INSTRUCTIONS FOR COMPLETING EXHIBIT 10-Q DISCLOSURE OF LOBBYING ACTIVITIES

This disclosure form shall be completed by the reporting entity, whether subawardee or prime federal recipient at the initiation or receipt of covered federal action or a material change to previous filing pursuant to title 31 U.S.C. Section 1352. The filing of a form is required for such payment or agreement to make payment to lobbying entity for influencing or attempting to influence an officer or employee of any agency, a Member of Congress an officer or employee of Congress or an employee of a Member of Congress in connection with a covered federal action. Attach a continuation sheet for additional information if the space on the form is inadequate. Complete all items that apply for both the initial filing and material change report. Refer to the implementing guidance published by the Office of Management and Budget for additional information.

1. Identify the type of covered federal action for which lobbying activity is or has been secured to influence, the outcome of a covered federal action.
2. Identify the status of the covered federal action.
3. Identify the appropriate classification of this report. If this is a follow-up report caused by a material change to the information previously reported, enter the year and quarter in which the change occurred. Enter the date of the last, previously submitted report by this reporting entity for this covered federal action.
4. Enter the full name, address, city, state, and zip code of the reporting entity. Include Congressional District if known. Check the appropriate classification of the reporting entity that designates if it is or expects to be a prime or subaward recipient. Identify the tier of the subawardee, e.g., the first subawardee of the prime is the first tier. Subawards include but are not limited to: subcontracts, subgrants, and contract awards under grants.
5. If the organization filing the report in Item 4 checks "Subawardee" then enter the full name, address, city, state, and zip code of the prime federal recipient. Include Congressional District, if known.
6. Enter the name of the federal agency making the award or loan commitment. Include at least one organization level below agency name, if known. For example, Department of Transportation, United States Coast Guard.
7. Enter the federal program name or description for the covered federal action (item 1). If known, enter the full Catalog of Federal Domestic Assistance (CFDA) number for grants, cooperative agreements, loans and loan commitments.
8. Enter the most appropriate federal identifying number available for the federal action identification in item 1 (e.g., Request for Proposal (RFP) number, Invitation for Bid (IFB) number, grant announcement number, the contract grant. or loan award number, the application/proposal control number assigned by the federal agency). Include prefixes, e.g., "RFP-DE-90-001."
9. For a covered federal action where there has been an award or loan commitment by the Federal agency, enter the federal amount of the award/loan commitments for the prime entity identified in item 4 or 5.
10. Enter the full name, address, city, state, and zip code of the lobbying entity engaged by the reporting entity identified in Item 4 to influence the covered federal action.
11. Enter the full names of the individual(s) performing services and include full address if different from 10 (a). Enter Last Name, First Name and Middle Initial (MI).
12. Enter the amount of compensation paid or reasonably expected to be paid by the reporting entity (Item 4) to the lobbying entity (Item 10). Indicate whether the payment has been made (actual) or will be made (planned). Check all boxes that apply. If this is a material change report, enter the cumulative amount of payment made or planned to be made.
13. Check all boxes that apply. If payment is made through an in-kind contribution, specify the nature and value of the in-kind payment.
14. Check all boxes that apply. If other, specify nature.
15. Provide a specific and detailed description of the services that the lobbyist has performed or will be expected to perform and the date(s) of any services rendered. Include all preparatory and related activity not just time spent in actual contact with federal officials. Identify the federal officer(s) or employee(s) contacted or the officer(s) employee(s) or Member(s) of Congress that were contacted.
16. Check whether or not a continuation sheet(s) is attached.
17. The certifying official shall sign and date the form, and print his/her name title and telephone number.

Public reporting burden for this collection of information is estimated to average 30-minutes per response, including time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Office of Management and Budget, Paperwork Reduction Project (0348-0046), Washington, D.C. 20503. SF-LLL-Instructions Rev. 06-04

**DBE INFORMATION - GOOD FAITH EFFORTS**

Bid Opening Date \_\_\_\_\_

Bidders shall make information on forthcoming opportunities available to DBEs and post solicitations for bids or proposals for a minimum of 30 calendar days in a local newspaper, before the bid opening date.

- A. The names and dates of each publication in which a request for DBE participation for this project was placed by the bidder (please attach copies of advertisements or proofs of publication):

<u>Publications</u>	<u>Dates of Advertisement</u>
_____	_____
_____	_____
_____	_____

- B. The names and dates of written notices sent to certified DBEs soliciting bids for this project and the dates and methods used for following up initial solicitations to determine with certainty whether the DBEs were interested (please attach copies of solicitations, telephone records, fax confirmations, etc.):

<u>Names of DBEs Solicited</u>	<u>Date of Initial Solicitation</u>	<u>Follow Up Methods and Dates</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____



- C. The items of work which the bidder made available to DBE firms including, where appropriate, any breaking down of the contract work items (including those items normally performed by the bidder with its own forces) into economically feasible units to facilitate DBE participation. It is the bidder's responsibility to demonstrate that sufficient work to facilitate DBE participation was made available to DBE firms.

Items of Work	Bidder Normally Performs Item (Y/N)	Breakdown of Items	Amount (\$)	Percentage Of Contract

- D. The names, addresses and phone numbers of rejected DBE firms, the reasons for the bidder's rejection of the DBEs, the firms selected for that work (please attach copies of quotes from the firms involved), and the price difference for each DBE if the selected firm is not a DBE:

Names, addresses and phone numbers of rejected DBEs and the reasons for the bidder's rejection of the DBEs:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Names, addresses and phone numbers of firms selected for the work above:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- E. Efforts made to assist interested DBEs in obtaining bonding, lines of credit or insurance, and any technical assistance or information related to the plans, specifications and requirements for the work which was provided to DBEs:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

F. Efforts made to assist interested DBEs in obtaining necessary equipment, supplies, materials or related assistance or services, excluding supplies and equipment the DBE subcontractor purchases or leases from the prime contractor or its affiliate:

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G. The names of agencies, organizations or groups contacted to provide assistance in contacting, recruiting and using DBE firms (please attach copies of requests to agencies and any responses received, i.e., lists, Internet page download, etc.):

Name of Agency/Organization	Method/Date of Contact	Results

H. Any additional data to support a demonstration of good faith efforts (use additional sheets if necessary):

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**NOTE:** USE ADDITIONAL SHEETS OF PAPER IF NECESSARY.



California State Water Resources Control Board  
Division of Financial Assistance  
1001 I Street • Sacramento, California 95814 • (916) 341-5700 FAX (916) 341-5707  
Mailing Address: P. O. Box 944212 • Sacramento, California • 94244-2120  
Internet Address: <http://www.waterboards.ca.gov>

## **Guidelines for Meeting the California State Revolving Fund (CASRF) Programs (Clean Water and Drinking Water SRF) Disadvantaged Business Enterprise Requirements**

The Disadvantaged Business Enterprise (DBE) Program is an outreach, education, and objectives program designed to increase the participation of DBEs in the Clean Water State Revolving Fund (CWSRF) and Drinking Water State Revolving Fund (DWSRF) Programs.

### **How to Achieve the Purpose of the Program**

Recipients of CWSRF/DWSRF financing that are subject to the DBE requirements (recipients) are required to seek, and are encouraged to use, DBEs for their procurement needs. Recipients should award a "fair share" of sub-agreements to DBEs. This applies to all sub-agreements for equipment, supplies, construction, and services.

The key functional components of the DBE Program are as follows:

- Fair Share Objectives
- DBE Certification
- Six Good Faith Efforts
- Contract Administration Requirements
- DBE Reporting

### **Disadvantaged Business Enterprises are:**

- Entities owned and/or controlled by socially and economically disadvantaged individuals as described by Title X of the Clean Air Act Amendments of 1990 (42 U.S.C. 7601 note) (10% statute), and Public Law 102-389 (42 U.S.C. 4370d) (8% statute), respectively;
- Minority Business Enterprise (MBE) - entities that are at least 51% owned and/or controlled by a socially and economically disadvantaged individual as described by Title X of the Clean Air Act Amendments of 1990 (42 U.S.C. 7601 note), and Public Law 102-389 (42 U.S.C. 4370d), respectively;
- Women Business Enterprise (WBE) - entities that are at least 51% owned and/or controlled by women;
- Small Business Enterprise (SBE);
- Small Business in a Rural Area (SBRA);
- Labor Surplus Area Firm (LSAF); or
- Historically Underutilized Business (HUB) Zone Small Business Concern or a concern under a successor program.

### **Certifying DBE Firms:**

Under the DBE Program, entities can no longer self-certify and contractors and sub-contractors must be certified at bid opening. Contractors and sub-contractors must provide to the CASRF recipient proof of DBE certification. Certifications will be accepted from the following:

- The U.S. Environmental Protection Agency (USEPA)
- The Small Business Administration (SBA)
- The Department of Transportation's State implemented DBE Certification Program (with U.S. citizenship)
- Tribal, State and Local governments
- Independent private organization certifications

If an entity holds one of these certifications, it is considered acceptable for establishing status under the DBE Program.

**Six Good Faith Efforts (GFE)**

All CWSRF/DWSRF financing recipients are required to complete and ensure that the prime contractor complies with the GFE below to ensure that DBEs have the opportunity to compete for financial assistance dollars.

1. Ensure DBEs are made aware of contracting opportunities to the fullest extent practical through outreach and recruitment activities. For Tribal, State and Local Government Recipients, this will include placing DBEs on solicitation lists and soliciting them whenever they are potential sources.
2. Make information on forthcoming opportunities available to DBEs. Posting solicitations for bids or proposals for a minimum of 30 calendar days in a local newspaper, before the bid opening date.
3. Consider in the contracting process whether firms competing for large contracts could subcontract with DBEs.
4. Encourage contracting with a group of DBEs when a contract is too large for one firm to handle individually.
5. Use the services of the SBA **and/or** Minority Business Development Agency (MBDA) of the US Department of Commerce.
6. If the prime contractor awards subcontracts, require the prime contractor to take the above steps.

The forms listed in the table below and attached to these guidelines; must be completed and submitted with the GFE:

FORM NUMBER	FORM NAME	REQUIREMENT	PROVIDED BY	COMPLETED BY	SUBMITTED TO
SWRCB Form 4500-2 or EPA Form	DBE Sub-Contractor Participation Form	As Needed to Report Issues	Recipient	Sub-contractor	EPA DBE Coordinator
SWRCB Form 4500-3 or EPA Form	DBE Sub-Contractor Performance Form	Include with Bid or Proposal Package	Prime Contractor	Sub-Contractor	SWRCB by Recipient
SWRCB Form 4500-4 or EPA Form	DBE Sub-Contractor Utilization Form	Include with Bid or Proposal Package	Recipient	Prime Contractor	SWRCB by Recipient

**The completed forms must be submitted with each Bid or Proposal.** The recipient shall review the bidder’s documents closely to determine that the GFE was performed **prior** to bid or proposal opening date. Failure to complete the GFE and to substantiate completion of the GFE before the bid opening date could jeopardize CWSRF/DWSRF financing for the project. The following situations and circumstances require action as indicated:

1. If the apparent successful low bidder was rejected, a complete explanation must be provided.
2. Failure of the apparent low bidder to **perform** the GFE **prior** to bid opening constitutes a non-responsive bid. The construction contract may then be awarded to the next low, responsive, and responsible bidder that meets the requirements or the Recipient may re-advertise the project.
3. If there is a bid dispute, all disputes shall be settled **prior** to submission of the Final Budget Approval Form.

**Administration Requirements**

- A recipient of CWSRF/DWSRF financing must require entities receiving funds to create and maintain a Bidders List if the recipient of the financing agreement is subject to, or chooses to follow, competitive bidding requirements.
- The Bidders list must include all firms that bid or quote on prime contracts, or bid or quote on subcontracts, including both DBEs and non-DBEs.

- Information retained on the Bidder's List must include the following:
  1. Entity's name with point of contact;
  2. Entity's mailing address and telephone number;
  3. The project description on which the entity bid or quoted and when;
  4. Amount of bid/quote; and
  5. Entity's status as a DBE or non-DBE.
- The Bidders List must be kept until the recipient is no longer receiving funding under the agreement.
- The recipient shall include Bidders List as part of the Final Budget Approval Form.
- A recipient must require its prime contractor to pay its subcontractor for satisfactory performance no more than 30 days from the prime contractor's receipt of payment from the Recipient.
- A recipient must be notified in writing by its prime contractor prior to any termination of a DBE subcontractor by the prime contractor.
- If a DBE subcontractor fails to complete work under the subcontract for any reason, the recipient must require the prime contractor to employ the six GFEs if soliciting a replacement subcontractor.
- A recipient must require its prime contractor to employ the six GFEs even if the prime contractor has achieved its fair share objectives.

### **Reporting Requirements**

For the duration of the construction contract(s), the recipient is required to submit to the State Water Resources Control Board DBE reports annually by October 10 of each fiscal year on the attached Utilization Report form (UR-334). Failure to provide this information as stipulated in the financial agreement language may be cause for withholding disbursements.

### **CONTACT FOR MORE INFORMATION**

SWRCB, CASRF – Barbara August (916) 341-6952 [barbara.august@waterboards.ca.gov](mailto:barbara.august@waterboards.ca.gov)

US EPA, Region 9 – Joe Ochab (415) 972-3761 [ochab.joe@epa.gov](mailto:ochab.joe@epa.gov)

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**Disadvantaged Business Enterprise (DBE) Program  
DBE Subcontractor Participation Form**

A Financial Assistance Agreement Recipient must require its prime contractors to provide this form to its DBE subcontractors. This form gives a DBE<sup>1</sup> subcontractor<sup>2</sup> the opportunity to describe work received and/or report any concerns regarding the funded project (e.g., in areas such as termination by prime contractor, late payments, etc.). The DBE subcontractor can, as an option, complete and submit this form to the DBE Coordinator at any time during the project period of performance.

Subcontractor Name		Project Name	
Bid / Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact	
Address			
Telephone No.		Email Address	
Prime Contractor Name		Issuing/Funding Entity	

<b>Contract Item Number</b>	<b>Description of Work Received from the Prime Contractor Involving Construction, Services, Equipment or Supplies</b>	<b>Amount Received by Prime Contractor</b>

<sup>1</sup> A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.2015 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

<sup>2</sup> Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an award of financial assistance.

Please use the space below to report any concerns regarding the above funded project:

Subcontractor Signature	Print Name
Title	Date

The public reporting and record keeping burden for this collection of information is estimated to average three (3) hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Do not send the completed form to this address.

**Send completed Form 4500-2 to:**  
Mr. Joe Ochab, DBE Coordinator  
US EPA, Region 9  
75 Hawthorne Street  
San Francisco, CA 94105

**FORM 4500-2 (DBE Subcontractor Participation Form)**





**Disadvantaged Business Enterprise (DBE) Program  
DBE Subcontractor Performance Form**

This form is intended to capture the DBE<sup>1</sup> subcontractor's<sup>2</sup> description of work to be performed and the price of the work submitted to the prime contractor. A Financial Assistance Agreement Recipient must require its prime contractor to have its DBE subcontractors complete this form and include all completed forms in the prime contractor's bid or proposal package.

Subcontractor Name		Project Name	
Bid / Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact	
Address			
Telephone No.		Email Address	
Prime Contractor Name		Issuing/Funding Entity	

Contract Item Number	Description of Work Submitted from the Prime Contractor Involving Construction, Services, Equipment or Supplies	Price of Work Submitted to the Prime Contractor
DBE Certified By: <input type="checkbox"/> DOT <input type="checkbox"/> SBA <input type="checkbox"/> Other: _____		Meets/exceeds EPA certification standards? <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> Unknown

<sup>1</sup> A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.2015 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.  
<sup>2</sup> Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an award of financial assistance.

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302 (c).

Prime Contractor Signature	Print Name
Title	Date

Subcontractor Signature	Print Name
Title	Date

The public reporting and record keeping burden for this collection of information is estimated to average three (3) hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Do not send the completed form to this address.

**FORM 4500-3 (DBE Subcontractor Performance Form)**



## Disadvantaged Business Enterprise (DBE) Program DBE Subcontractor Utilization Form

This form is intended to capture the prime contractor's actual and/or anticipated use of identified certified DBE<sup>1</sup> subcontractor's<sup>2</sup> and the estimated dollar amount of each subcontract. A Financial Assistance Agreement Recipient must require its prime contractors to complete this form and include it in the bid or proposal package. Prime contractors should also maintain a copy of this form on file.

Prime Contractor Name		Project Name	
Bid / Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact	
Address			
Telephone No.		Email Address	
Issuing/Funding Entity			

I have identified potential DBE certified subcontractors. ___ YES ___ NO If yes, please complete the table below. If no, please explain:			
Subcontractor Name/ Company Name	Company Address / Phone / Email	Estimated Dollar Amount	Currently DBE Certified?

--Continue on back if needed--

<sup>1</sup> A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.2015 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

<sup>2</sup> Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an award of financial assistance.

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302 (c).

Prime Contractor Signature	Print Name
Title	Date

The public reporting and record keeping burden for this collection of information is estimated to average three (3) hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Do not send the completed form to this address.

**FORM 4500-4 (DBE Subcontractor Utilization Form)**



**STATE WATER RESOURCES CONTROL BOARD – DIVISION OF FINANCIAL ASSISTANCE  
DISADVANTAGED BUSINESS ENTERPRISE (DBE) UTILIZATION  
CALIFORNIA STATE REVOLVING FUNDS (CASRF)  
FORM UR-334**

1. Grant/Finance Agreement Number:		2. Annual Reporting Period 10/1/___ through 09/30/___		3. Purchase Period of Financing Agreement:	
4. Total Payments Paid to Prime Contractor or Sub-Contractors During Current Reporting Period: \$					
5. <u>Recipient's Name and Address:</u>			6. <u>Recipient's Contact Person and Phone Number:</u>		
7. List All DBE Payments Paid by Recipient or Prime Contractor During Current Reporting Period:					
Payment or Purchase Paid by Recipient or Prime Contractor	Amount Paid to Any DBE Contractor or Sub-Contractor For Service Provided to Recipient		Date of Payment (MM/DD/YY)	Procurement Type Code** (see below)	Name and Address of DBE Contractor of Sub-Contractor or Vendor
	MBE	WBE			
8. Initial here if no DBE contractors or sub-contractors paid during current reporting period:					
9. Initial here if all procurements for this contract are completed:					
10. Comments:					
11. Signature and Title of Recipient's Authorized Representative			12. Date		

**Email Form UR-334 to:**

[DrinkingWaterSRF@waterboards.ca.gov](mailto:DrinkingWaterSRF@waterboards.ca.gov) OR [CleanWaterSRF@waterboards.ca.gov](mailto:CleanWaterSRF@waterboards.ca.gov)

**Questions may be directed to:**

Barbara August, SWRCB  
[Barbara.August@waterboards.ca.gov](mailto:Barbara.August@waterboards.ca.gov)  
 Phone: (916) 341-6952  
 Fax: (916) 327-7469

**\*\*Procurement Type:**

1. Construction
2. Supplies
3. Services (includes business services; professional services; repair services and personnel services)
4. Equipment

**STATE WATER RESOURCES CONTROL BOARD - DIVISION OF FINANCIAL ASSISTANCE  
DISADVANTAGED BUSINESS ENTERPRISE (DBE) UTILIZATION  
CALIFORNIA STATE REVOLVING FUNDS**

**INSTRUCTIONS FOR COMPLETING FORM UR-334**

- Box 1** Grant or Financing Agreement Number.
- Box 2** Annual reporting period.
- Box 3** Enter the dates between which you made procurements under this financing agreement or grant.
- Box 4** Enter the total amount of payments paid to the contractor or sub-contractors during this reporting period.
- Box 5** Enter Recipient's Name and Address.
- Box 6** Enter Recipient's Contact Name and Phone Number.
- Box 7** Enter details for the **DBE purchases only** and be sure to limit them to the current period.  
1) Use either an "R" or a "C" to represent "Recipient" or "Contractor." 2) Enter a dollar total for DBE and total the two columns at the bottom of the section. 3) Provide the payment date. 4) Enter a product type choice from those at the bottom of the page. 5) List the vendor name and address in the right-hand column
- Box 8** Initial here if no DBE contractors or sub-contractors were paid during this reporting period.
- Box 9** Initial this box only if all purchases under this financing agreement or grant have been completed during this reporting period or a previous period. If you initial this box, we will no longer send you a survey.
- Box 10** This box is for explanatory information or questions.
- Box 11** Provide an authorized representative signature.
- Box 12** Enter the date form completed.

(This guaranty shall be executed by the successful bidder in accordance with instructions in the special provisions. The bidder may execute the guaranty on this page at the time of submitting his bid.)

**G U A R A N T Y**

To the Owner: County of Fresno

**CONTRACT NUMBER 23-13-C**

The undersigned guarantees the construction and installation of the following work included in this project:

**ALL WORK**

Should any of the materials or equipment prove defective or should the work as a whole prove defective, due to faulty workmanship, material furnished or methods of installation, or should the work or any part thereof fail to operate properly as originally intended and in accordance with the plans and specifications, due to any of the above causes, all within twelve (12) months after date on which this contract is accepted by the Owner, the undersigned agrees to reimburse the Owner, upon demand, for its expenses incurred in restoring said work to the condition contemplated in said project, including the cost of any such equipment or materials replaced and the cost of removing and replacing any other work necessary to make such replacement or repairs, or, upon demand by the Owner, to replace any such material and to repair said work completely without cost to the Owner so that said work will function successfully as originally contemplated.

The Owner shall have the unqualified option to make any needed replacement or repairs itself or to have such replacements or repairs done by the undersigned. In the event the Owner elects to have said work performed by the undersigned, the undersigned agrees that the repairs shall be made and such materials as are necessary shall be furnished and installed within a reasonable time after the receipt of demand from the Owner.

Name (Printed): \_\_\_\_\_

Signature: \_\_\_\_\_

Title: \_\_\_\_\_

Date: \_\_\_\_\_

Contractor: \_\_\_\_\_

# AGREEMENT

THIS AGREEMENT made at Fresno, in Fresno County, California, by and between \_\_\_\_\_ hereinafter called the Contractor, and the County of Fresno hereinafter called the Owner.

WITNESSETH: That the Contractor and the Owner, for the consideration hereinafter named, agree as follows:

**ARTICLE I.** The Contractor agrees to furnish all labor and materials, including tools, implements, and appliances required, but excluding such materials as are mentioned in the specifications to be furnished by the Owner, and to perform all the work in a good and workmanlike manner, free from any and all liens and claims of mechanics, materialmen, teamsters, subcontractors, artisans, machinists, and laborers required for:

## **CSA 30 & 32 WELL SITE IMPROVEMENTS AND MANGANESE TREATMENT CONTRACT**

**STATE WATER RESOURCES CONTROL BOARD PROJECT NUMBER: 1000359-005C**

**CONTRACT NUMBER: 23-13-C**

All in strict compliance with the plans, drawings and specifications therefor prepared by the Owner, and other contract documents relating thereto.

**ARTICLE II.** The Contractor and the Owner agree that the Notice to Bidders and Special Provisions, the Wage Scale (Prevailing Wages), the Plans and Drawings, Addenda and Bulletins thereto, and the Proposal (Bid Book) hereto attached, together with this Agreement, form the contract, and they are as fully a part of the contract as if hereto attached or herein repeated.

All portions of the Standard Specifications of the State of California, Department of Transportation, dated 2015, which are not in conflict with this contract shall be deemed a part of the specifications as though fully therein set forth; provided, however, that revisions to the said Standard Specifications shall apply only to the extent, if any, included in the Project Details of these specifications or as otherwise incorporated directly herein. No part of said specifications which is in conflict with any portion of this agreement, or which is not actually descriptive of the work to be done thereunder, or of the manner in which said work is to be executed, shall be considered as any part of this agreement, but shall be utterly null and void.

**ARTICLE III.** The Owner agrees to pay the Contractor in current funds for the performance of the contract the sum of \_\_\_\_\_ **DOLLARS AND xx/100** (\_\_\_\_\_.) it being understood that said price is based upon the estimated quantities of materials to be used as set forth in the Proposal, except where provisions are made in the contract documents whereby the estimated quantities shall constitute the final quantity; that upon completion of the project the final contract prices shall be revised by change order, if necessary, to reflect the true quantities used at the stated unit price thereof as contained in the Contractor's Proposal hereto attached. Payments on account thereof will be made as set forth in the special provisions.

**ARTICLE IV.** If the Contractor should be adjudged a bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed on account of his insolvency, or if he or any of his subcontractors should persistently violate any of the provisions of the contract, or if he should persistently or repeatedly refuse or should fail, except in cases for which extension of time is provided, to supply enough properly skilled workmen or proper materials, or if he should fail to make prompt payment to subcontractors or for material or labor, or persistently disregard laws, ordinances or the instructions of the Engineer, then the Owner may, upon certificate of the **Contract Number 23-13-C**



Engineer when sufficient cause exists to justify such action, serve written notice upon the Contractor and his surety of its intention to terminate the contract, and unless within five days after the serving of such notice, such violations shall cease and satisfactory arrangements for correction thereof be made, the contract shall, upon the expiration of said five days, cease and terminate.

In the event of any such termination, the Owner shall immediately serve written notice thereof upon the surety and the Contractor, and the surety shall have the right to take over and perform the contract, provided, however, that if the surety within ten (10) days after the serving upon it of notice of termination does not give the Owner written notice of its intention to take over and perform the contract or does not commence performance thereof within the ten (10) days stated above from the date of the serving of such notice, the Owner may take over the work and prosecute the same to completion by contract or by any other method it may deem advisable, for the account and at the expense of the Contractor, and the Contractor and his surety shall be liable to the Owner for any excess cost occasioned the Owner thereby, and in such event the Owner may without liability for so doing, take possession of and utilize in completing the work such materials, appliances, plant and other property belonging to the Contractor as may be on the site of the work and necessary therefor. In such case the Contractor shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the contract price shall exceed the expenses of finishing the work, including compensation for additional managerial and administrative services, such excess shall be paid to the Contractor. If such expense shall exceed such unpaid balance, the Contractor shall pay the difference to the Owner. The expense incurred by the Owner, as herein provided and damage incurred through the Contractor's default, shall be certified by the Engineer.

**ARTICLE V.** To the fullest extent permitted by law with respect to any work required to be done under this contract, the Contractor will indemnify and hold harmless the COUNTY OF FRESNO, STATE OF CALIFORNIA, UNITED STATES OF AMERICA, PROVOST & PRITCHARD, STATE WATER RESOURCES CONTROL BOARD and all other participating public agencies, whether or not said agencies are named herein, who have jurisdiction within the areas in which the work is to be performed, and all officers and employees of the Owner, the County, the State, the United States and said other participating agencies, from any and all costs and expenses, attorney fees and court costs, damages, liabilities, claims and losses occurring or resulting to COUNTY in connection with the performance, or failure to perform, by CONTRACTOR, its officers, agents or employees under this Agreement, and from any and all costs and expenses, attorney fees and court costs, damages, liabilities, claims and losses occurring or resulting to any person, firm or corporation who may be injured or damaged by the performance, or failure to perform, of CONTRACTOR, its officers, agents or employees under this Agreement. In addition, CONTRACTOR agrees to indemnify COUNTY for Federal, State of California and/or local audit exceptions resulting from non-compliance herein on the part of CONTRACTOR.

CONTRACTOR agrees to indemnify, save, hold harmless, and at COUNTY'S request, defend the COUNTY, its officers, agents, and employees from any and all costs and expenses, damages, liabilities, claims, and losses occurring or resulting to COUNTY in connection with the performance, or failure to perform, by CONTRACTOR, its officers, agents, or employees under this Agreement, and from any and all costs and expenses, damages, liabilities, claims, and losses occurring or resulting to any person, firm, or corporation who may be injured or damaged by the performance, or failure to perform, of CONTRACTOR, its officers, agents, or employees under this Agreement.

The Certificate of Insurance shall be issued in duplicate, to the COUNTY OF FRESNO, PROVOST & PRITCHARD, STATE WATER RESOURCES CONTROL BOARD, and all other participating agencies, whether or not said agencies are named herein, who contribute to the cost of the work or have jurisdiction over areas in which the work is to be performed and all officers and employees of said agencies while acting within the course and scope of their duties and responsibilities.

In the event CONTRACTOR fails to keep in effect at all times insurance coverage as herein provided, the COUNTY may, in addition to other remedies it may have, suspend or terminate this Agreement upon the occurrence of such event.

All policies shall be with admitted insurers licensed to do business in the State of California. Insurance purchased shall be purchased from companies possessing a current A.M Best Company rating of A FSC VII or better.

Without limiting the COUNTY’S right to obtain indemnification from CONTRACTOR or any third parties, CONTRACTOR, at its sole expense, shall maintain in full force and effect, the following insurance policies or a program of self-insurance, including but not limited to, an insurance pooling arrangement or Joint Powers Agreement (JPA) throughout the term of the Agreement:

A. Commercial General Liability

Commercial General Liability Insurance with limits not less than those shown in the following table:

**Liability Insurance Requirements**

Total bid	For each occurrence <sup>a</sup>	Aggregate for products/completed operation	General aggregate <sup>b</sup>	Umbrella or excess liability <sup>c</sup>
≤ \$1,000,000	\$1,000,000	\$2,000,000	\$2,000,000	\$5,000,000
> \$1,000,000	\$1,000,000	\$2,000,000	\$2,000,000	\$10,000,000
≤ \$10,000,000				
> \$10,000,000	\$2,000,000	\$2,000,000	\$4,000,000	\$15,000,000
≤ \$25,000,000				
> \$25,000,000	\$2,000,000	\$2,000,000	\$4,000,000	\$25,000,000

<sup>a</sup>Combined single limit for bodily injury and property damage.

<sup>b</sup>This limit must apply separately to your work under this Contract.

<sup>c</sup>The umbrella or excess policy must contain a clause stating that it takes effect (drops down) in the event the primary limits are impaired or exhausted.

This policy shall be issued on a per occurrence basis. COUNTY may require specific coverages including completed operations, products liability, contractual liability, Explosion-Collapse-Underground, fire legal liability, or any other liability insurance deemed necessary because of the of the nature of this contract.

Such Commercial General Liability insurance shall name the County of Fresno, its officers, agents, and employees, individually and collectively, as additional insured, but only insofar as the operations under this Agreement are concerned. Such coverage for additional insured shall apply as primary insurance and any other insurance, or self-insurance, maintained by COUNTY, its officers, agents and employees shall be excess only and not contributing with insurance provided under CONTRACTOR's policies herein. This insurance shall not be cancelled or changed without a minimum of thirty (30) days advance written notice given to COUNTY. CONTRACTOR shall obtain endorsements to the Commercial General Liability insurance policy naming COUNTY as an additional insured and providing for a thirty (30) day prior written notice of cancellation or change in terms or coverage.

Within eight (8) days from date CONTRACTOR executes this Agreement, CONTRACTOR shall provide certificates of insurance and endorsement as stated above for all of the foregoing policies, as required herein, to the County of Fresno, or to [designservices@fresnocountyca.gov](mailto:designservices@fresnocountyca.gov), stating that such insurance coverages have been obtained and are in full force; that the County of Fresno, its officers, agents and employees will not be responsible for an premiums on the policies; that such Commercial General Liability insurance names the County of Fresno, its officers, agents, and employees, individually and collectively, as additional insured, but only insofar as the operations under this Agreement are concerned; that such coverage for additional insured shall apply as primary insurance an any other insurance, or self- insurance shall not be cancelled or changed without a minimum of thirty (30) days advance, written notice given to COUNTY.

CONTRACTOR shall obtain endorsements to the Commercial General Liability insurance naming the County of Fresno, its officers, agents, and employees, individually and collectively, as additional insured, but only insofar as the operations under this Agreement are concerned. Such coverage for additional insured shall apply as primary insurance and any other insurance, or self-insurance, maintained by COUNTY, its officers, agents, and employees shall be excess only and not contributing with insurance provided under CONTRACTOR'S policies herein. This insurance shall not be cancelled or changed without a minimum of thirty (30) days advance written notice given to COUNTY.

#### B. Automobile Liability

Comprehensive Automobile Liability Insurance with limits of not less than One Million Dollars (\$1,000,000) per accident for bodily injury and property damage. Coverage should include owned and non-owned vehicles used in connection with this Agreement and all applicable endorsements.

#### C. Professional Liability

If CONTRACTOR is a licensed professional or employs professional staff, (e.g., Architect, Engineer, Surveyor, etc.) in providing services, Professional Liability Insurance with limits of not less than One Million Dollars (\$1,000,000.00) per occurrence, Three Million Dollars (\$3,000,000.00) annual aggregate with a provision for 3 year tail coverage.

#### D. Worker's Compensation

A policy of Worker's Compensation insurance as may be required by the California Labor Code.

**ARTICLE VI.** Contractor represents that he has secured the payment of Worker's Compensation in compliance with the provisions of the Labor Code of the State of California and during the performance of the work contemplated herein will continue so to comply with said provisions of said Code. Contractor shall supply the Owner with certificates of insurance, in duplicate, evidencing that Worker's Compensation Insurance is in effect and providing that the Owner will receive ten days notice of cancellation. If Contractor self-insures Worker's Compensation, Certificate of Consent to Self-insure should be provided the Owner.

**ARTICLE VII.** The Contractor shall forthwith furnish in duplicate, a faithful performance bond in an amount equal to 100% of the contract price and a payment bond in an amount equal to 100% of the contract price, both bonds to be written by a surety company acceptable to the Owner and in the form prescribed by law.

The payment bond shall contain provisions such that if the Contractor or his subcontractors shall fail to pay (a) amounts due under the Unemployment Insurance Code with respect to work performed under the contract, or (b) any amounts required to be deducted, withheld and paid over to the Employment Development Department and to the Franchise Tax Board from the wages of the employees of the Contractor and subcontractors pursuant to Section 13020 of the Unemployment Insurance Code with respect to such work and labor, then the surety will pay these amounts. In case suit is brought upon the payment bond, the surety will pay a reasonable attorney's fee to be fixed by the court.

**ARTICLE VIII.** This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations.

Except as provided in Labor Code section 1725.5(f), no contractor or subcontractor may be listed on a bid proposal for a public works project unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5 [with limited exceptions from this requirement for bid purposes only under Labor Code section 1771.1(a)].

Except as provided in Labor Code section 1725.5(f), no contractor or subcontractor may be awarded a contract for public work on a public works project or engage in the performance of work on any public

works project unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.

Contractor shall comply with all applicable laws and regulations relating to wages and employment, including all requirements imposed by the California Department of Industrial Relations (DIR). Contractor shall cooperate with County to furnish timely all information necessary for County's completion of the form required to be submitted by County when registering the Project on the DIR website; and County thereafter shall provide to Contractor the "Project ID Number" assigned by DIR in order to facilitate Contractor's submission to DIR of its certified payrolls for the Project, in the manner required and using such form as may be prescribed by DIR, in accordance with the provisions of Labor Code section 1771.4(a)(3).

**ARTICLE IX: Governing Law – Venue** for any action arising out of or relating to this Agreement shall be in Fresno County, California. This Agreement shall be governed by the laws of the State of California.

**ARTICLE X: USE OF UNITED STATES FLAG VESSELS:** The Contractor agrees:

(1) To utilize privately owned United States-flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to this contract, to the extent such vessels are available at fair and reasonable rates for United States-flag commercial vessels.

"(2) To furnish within 20 days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, 'on-board' commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph (1) of this section to both the Contracting Officer (through the prime contractor in the case of subcontractor bills-of-lading) and to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590.

"(3) To insert the substance of the provisions of this clause in all subcontracts issued pursuant to this contract.

**ARTICLE XII: AIS REQUIREMENT** The Contractor acknowledges to and for the benefit of the County of Fresno and the State of California that it understands the goods and services under this Agreement are being funded with monies made available by the Clean Water State Revolving Fund and/or Drinking Water State Revolving Fund that have statutory requirements commonly known as "American Iron and Steel;" that requires all of the iron and steel products used in the project to be produced in the United States ("American Iron and Steel Requirement") including iron and steel products provided by the Contractor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Purchaser and the State that (a) the Contractor has reviewed and understands the American Iron and Steel Requirement, (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirement, as may be requested by the Purchaser or the State. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser or State to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Purchaser or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Purchaser). While the Contractor has no direct contractual privity with the State, as a lender to the Purchaser for the funding of its project, the Purchaser and the Contractor agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State.

**Contract Number 23-13-C**

This Contract, **23-13-C**, was awarded by the Board of Supervisors on \_\_\_\_\_. It has been reviewed by the Department of Public Works and Planning and is in proper order for signature of the Chairman of the Board of Supervisors.

**ARTICLE XII: MINIMUM FEDERAL WAGE RATES** The **Minimum Federal Wage Rates Determination** is hereby physically attached, in conformance with federal 10-day rule as a part of this contract (Exhibit A). This wage rate determination applies to federal-aid contracts and all work performed exceeding \$2000 by subcontracts and subsequent lower-tier subcontracts and is required to be physically included in each executed contract.

IN WITNESS WHEREOF, they have executed this Agreement this \_\_\_\_\_ day of \_\_\_\_\_, 2023

\_\_\_\_\_  
(CONTRACTOR)

COUNTY OF FRESNO  
(OWNER)

By \_\_\_\_\_

By \_\_\_\_\_  
Sal Quintero, Chairman  
of the Board of Supervisors of the  
County of Fresno

Title \_\_\_\_\_

**ATTEST:**  
Bernice E. Seidel  
Clerk of the Board of Supervisors  
County of Fresno, State of California

By \_\_\_\_\_  
Deputy

# Exhibit A Minimum Federal Wage Rates Determination

[www.sam.gov](http://www.sam.gov)