CITY OF ARVIN

URBAN GREENING PATHWAYS PROJECT

City capital project #: 1902

PART 2
TECHNICAL SPECIFICATIONS

7-10-20
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SECTION 02202
EARTHWORK

PART 1 GENERAL

1.1 Summary:

A. Section Includes:

This section includes all earthwork pertaining to roadway grading including, but not limited to furnishing all labor and equipment necessary for clearing, stripping and grubbing; preparation of ground surfaces and subgrade to receive fill; excavation; placement and compaction of structural and non-structural fill; disposal of excess materials and products of clearing, grubbing, and stripping; and any other work necessary to bring ground elevations to the lines and grades shown in the Plans.

B. Related Sections:

Section 02230 – Clearing and Grubbing
Section 02232 – Selective Demolition
Section 02233 - Sawcut
Section 02302 - Trenching and Backfilling
Section 02530 - Aggregate Base Course

1.2 References:

A. ASTM D422 - Particle Size Analysis for Soils.
B. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
D. ASTM D2216 - Test Method for Laboratory Determination of Water content.
G. ASTM D3017 - Test Method for Moisture content in Place by Nuclear Methods.
J. California Test Method 229 - Test for Durability Index.
1.3 Description:

A. Provide all materials, labor, services and equipment required for excavating for roadway paving grade, curbs, gutters, sidewalks and utilities; grading for backfilling, compacting, and grading as required for completion of the work.

Verify shrinkage characteristics of imported soils and existing soils to be reused.

The City will not be responsible for additional costs associated with variations in shrinkage factors and related earthwork quantities.

The City makes no representation regarding the balance of cut and fill earthwork on the site. The Contractor is responsible for the calculation of cut and fill required and available, for the cost of obtaining fill required, and for the cost of disposal of surplus.

B. Excavations and filling and backfill material shall have the acceptance of the City Representative. Work shall be done only under the general observation of the City Representative.

1.4 Dust Control:

A. Contractor shall obtain a dust control permit from the San Joaquin Valley Air Pollution Control District (SJVAPCD) (661-326-6424) prior to performing earth disturbing activities. It shall be the Contractor's responsibility to prevent a dust nuisance from originating from the site of the work as a result of his operations, or the traveling public, during the effective period of this contract. Preventative measures to be taken by the Contractor shall include but shall not be limited to the following:

B. Water shall be applied to all unpaved areas as required to prevent the surface from becoming dry enough to permit dust formation.

C. Paved surfaces over which vehicular traffic is permitted to travel shall be kept free of dirt. In high traffic, a self-contained, pick-up type, power broom with water distribution system shall be used.

D. Temporary suspension of the work, either as a result of order by the Engineer, or as a result of conditions beyond the control of the Contractor shall not relieve the Contractor from his responsibility for dust control as set forth herein.

1.5 Storm Water Pollution Prevention Plan:

A. Water pollution control work shall conform to the requirements in the Construction Contractor’s Guide and Specifications of the Caltrans Storm Water Quality Handbooks. Copies are available from Caltrans or on the web at https://dot.ca.gov/programs/construction/storm-water-and-water-pollution-control. The Contractor shall submit the necessary forms and pay necessary fees to the State Water Resources Control Board prior to the start of construction. The Contractor shall be responsible for the costs and for any liability imposed by law as a result of the Contractor’s failure to comply with the requirements set forth in this section.

Depending on project size, a WDID number may be required prior to beginning work. This shall be obtained by the contractor.

B. At a minimum, the following Best Management Practices (BMP) shall be included:

NS-01 Non-Stormwater Management,
C. The Contractor shall be continuously responsible for erosion and sedimentation control and storm water pollution prevention throughout the contract period. All erosion and sedimentation control measures shall be installed concurrently with ground-disturbing construction activities and shall remain in place until completion of the contract or ground disturbing activity. The BMP’s previously listed represent the minimum erosion and sedimentation control effort required by the contractor. The Contractor shall implement all other measures required to prevent erosion, pollutant discharge, and siltation of streams and dry washes at no additional cost to the City. The Contractor shall monitor, inspect, repair, and maintain erosion control measures at the end of each working day and following each storm event as follows: Prior to a forecast storm, after each storm, at 24-hour intervals during extended precipitation events and routinely on a weekly basis.

1.6 Submittals:
A. Submit under provisions of Section 01 33 00.
B. Independent Testing Laboratory Reports: Indicate results of specified tests.
C. Survey Data for Completed Grading: Submit supporting survey data indicating completed grading conforms to contact requirements. Submit drawings showing record elevations marked on the grading plans.

1.7 Quality Assurance:
A. Earth Fill Compaction: Per California Code of Regulations, Title 24, Part 2.
B. All costs for initial compaction tests shall be borne by the Owner. All areas that fail to meet the minimum compaction requirements shall be reworked as required by the City Engineer and retested until minimum compaction requirements are obtained.
C. The cost of any retests, including time for the City Engineer, shall be borne by the Contractor at no additional cost to the project. Testing will be required as directed by the City Engineer. Test locations shall be determined by the City Engineer upon notification from the Contractor that the grade is ready for tests. Contractor shall be present when samples of bedding and backfill materials are gathered for analysis or testing.
1.8 Storage and Handling:
   A. Cover and protect earth materials stockpiled for use on the work from erosion and contamination.

1.9 Environmental Conditions:
   A. Weather: Protect bearing surfaces under foundations. Should bearing surfaces become softened, excavate to solid bearing and fill with concrete, mix and strength as accepted, to elevations indicated.
   B. No fill material shall be placed, spread or rolled if weather conditions increase the moisture content above permissible limits. When work is interrupted by rain, the earthwork operations shall not be resumed until directed by the City Representative.

1.10 Performance:
   A. The Contractor shall complete all earthwork in accordance with project plans and specifications. No variance from plans and specifications shall be permitted without written acceptance of the Engineer, or his designated representative, hereinafter referred to as the “Geotechnical Engineer.” Earthwork shall not be considered complete until the “Engineer” has issued a written statement confirming substantial compliance of earthwork operations to these specifications and to project plans.
   B. The Contractor shall assume sole responsibility for job site conditions during the course of earthwork operations on the project, including safety of all persons and preservation of all property; this requirement shall apply continuously and not be limited to normal working hours. The Contractor shall defend, indemnify, and hold harmless the City, Engineer, and Soils Engineer from any and all liability and claims, real or alleged, arising out of performance of earthwork on this project, except from liability incurred through sole negligence of the City, the Engineer, or the Geotechnical Engineer.

PART 2 PRODUCTS

2.1 ENGINEERED FILL
   A. Engineered Fill is material to be placed beneath structures or pavements to the limits indicated on the drawings.
   B. Engineered Fill material shall be free of organics and other debris and less than 3-inches in maximum dimension. Native soils may be used if they contain objects less than 3-inch in maximum dimension and contain less than 3 percent organic materials by weight (ASTM D2974).
   C. Import Fill to be used as Engineered Fill shall be non-hazardous, non-corrosive, be derived from a single, consistent source and meet the following criteria:
      1. Gradation (ASTM C136)
      2. Expansion index (ASTM D4829)
      3. Plasticity (ASTM D4318)
      4. Organic Content (ASTM D2974)
      5. Corrosivity Potential (pH, Minimum resistivity (ohm-cm), Soluble Sulfate (ppm), Soluble Chloride (ppm))
6. Resistance Value (CTM 301)
7. Import fill material that meets Engineered Fill should

2.2 ENGINEERED BACKFILL

A. Engineered Backfill is material to be placed adjacent to and around piping, structures, and areas not subject to adjacent structure foundation loading (areas not subject to adjacent structure foundation loading are areas from a distance 5 feet beyond the edge of structural slab or footing).

B. Engineered Backfill and Imported Fill to be used as Engineered Backfill shall comply with the requirements of Engineered Fill.

2.3 FILL

A. Fill material is material that is to be placed in locations that are not to be constructed as engineered fill or backfill. Fill material may be native material.

2.4 SAND

A. Sand is granular material free from clay balls, organic matter, and other deleterious substances.

B. Sand shall be of such size that 90 percent to 100 percent will pass the number 4 sieve and not more than 5 percent will pass the number 200 sieve per Caltrans Sand bedding specification.

C. Sand shall have a minimum sand equivalent of 30 per ASTM D2419.

2.5 WATER FOR COMPACTION

A. Water shall be free of organic materials and shall have a pH of 7.0 to 9.0, a maximum chloride concentration of 500-mg/L, and a maximum sulfate concentration of 500-mg/L. Provide all water needed for earthwork. Provide temporary piping and valves to convey water from the source to the point of use. Water will be provided without charge from the Greenfield County Water District system. Greenfield County Water District will provide a meter if the water is taken from the District pipelines.

2.6 AGGREGATE BASE

A. Use ¾-inch maximum, Class 2 Aggregate base material per Caltrans’ Standard Specifications, Section 26 and Section 02530 - Aggregate Base Courses.

PART 3 EXECUTION

3.1 EXAMINATION

A. Prior to commencing work:

Verify existing grades and conditions are as indicated on drawings.
Verify existing building pad locations, grades, and conditions are as indicated on drawings issued under other contracts.
B. Should indicate conditions conflict with actual conditions and contours, notify the City Representative and await their directions before proceeding. Commencement of work indicates acceptance of existing conditions.

C. The Contractor shall visit the site, prior to bid submittal, to determine existing soil and topographic conditions, and the nature of materials that may be encountered during the course of the work under this contract, and make his own interpretation of the contents of the Geotechnical Report, as they pertain to said conditions.

D. The Contractor shall inspect the site and satisfy himself of any existing soil conditions. If the Contractor relies upon any non-factual information, such as opinions, interpretations of the facts, extrapolations, comments on the facts, or inferences drawn from the facts, he does so at his own risk. The City shall not be liable for any costs incurred as a result of the Contractor’s election to rely upon such non-factual information.

3.2 Excavation:

A. Provide excavation of whatever nature is required for construction of the work. Excavation generally consists of grading required to remove existing structures and utilities within the areas designated for clearing, grubbing and stripping shown on the plans. This includes removal of soil for replacement and recompaction as shown and described on the plans. Perform all excavation work in compliance with applicable requirements of authorities having jurisdiction.

B. Excavate and remove earth materials encountered within areas scheduled for subgrade construction in accordance with the Plans and Specifications.

C. Extend excavations a sufficient distance to permit placing and removal of forms, installation of services, waterproofing and gravel base course where indicated.

D. Excavate to solid bearing at elevation no higher than those indicated on drawings for footings and other “on grade” construction.

E. In excavating for footings, take care not to disturb bottom of excavation. Trim bottoms to required lines and grades to leave solid base to receive concrete.

F. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction by the City Representative.

If excavations for footings and foundations are made deeper than indicated or ordered, fill with same concrete as specified for footings, at Contractor’s expense. No earth fill will be permitted under footings and foundations.

If excavations for slabs or flatwork area are made deeper than indicated, fill with sand or nonexpansive sand soil. Compact at optimum moisture content to 90 percent density, ASTM D1557.

G. Excavations shall be cut to elevations plus or minus 0.1 foot of the grades shown on the Plans.

H. When excavated materials are to be used in engineered fill, the excavation shall be made in a manner to produce as much mixing of the excavated materials as practicable.
I. When excavations are to be backfilled and where surfaces exposed by excavation are to support structures or concrete floor slabs, the exposed surfaces shall be scarified, moistened and compacted, as stated above for areas to receive fill. Over excavation below specified depths will not eliminate the requirement for exposed surface compaction.

J. All excavation will be performed as unclassified excavation. This includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered.

3.3 Backfill:

A. Surfaces to receive fill shall be scarified and compacted to a depth of at least six (6.0) inches, or as shown on the Plans, whichever is greater, until the surface is free from ruts, hummocks or other uneven features which would tend to prevent uniform compaction by the equipment to be used.

B. After the area to receive fill has been cleared and scarified, it shall be moistened and compacted to a depth of at least six (6.0) inches in accordance with specifications for compacting fill material.

C. Backfilling shall consist of placing and compacting backfill material in excavations to the finish grades shown. Do no backfilling until each specific location is approved by the City Representative.

D. Place fills and backfill in lifts, before compaction, not to exceed 6 inches for hand operated mechanical compactors and not to exceed 8 inches for heavy equipment compactors.

E. Spread each layer evenly; thoroughly mix each layer during the spreading to ensure uniformity of material and moisture in each layer.

F. After placement, thoroughly compact to 95 percent of the maximum dry density obtained by the ASTM D1557 test method as indicated from Testing Laboratory Results.

3.4 Fill Materials:

A. Materials obtained from on-site excavations will be generally considered satisfactory for construction of on-site engineered fills based on the Geotechnical Report. If unexpected pockets of poor or weak materials are encountered in excavations, and they cannot be up-graded by mixing with other materials or by other means, they may be rejected by the City Representative, based on the advice of the Geotechnical Engineer, for use in engineered fill.

B. When imported fill materials are necessary to bring the site up to planned grades, no material shall be imported prior to its review and acceptance by the Geotechnical Engineer.

C. The Contractor shall give notice to the City Representative and the Geotechnical Engineer of the proposed source of imported materials with adequate time allowance for his testing of the proposed materials. The time required for testing will vary with different types of materials, job conditions, and ultimate function of filled areas. Under best conditions the time requirement will not be less than 48 hours.
D. The fill material shall be placed in layers which, when compacted, shall not exceed six (6.0) inches in thickness. Each layer shall be spread evenly and shall be thoroughly mixed during the spreading to insure uniformity of material in each layer. Increased thickness of layers may be accepted by the City Representative based on the recommendation of the Geotechnical Engineer when conditions warrant.

E. All fills shall be placed in level layers; layers shall be continuous over the area of any structural unit, and all portions of the fill shall be brought up simultaneously within the area of any structural unit. When imported material is used, it must be placed so that its thickness is as uniform as possible within the area of any structural unit.

F. When materials are to be excavated and replaced in a compacted condition, segmented, or leap-frogging of cut-fill operation within the area of any structural unit will not be permitted unless the method is specifically accepted in writing by the City Representative based on the recommendation of the Geotechnical Engineer.

G. When the moisture content of fill material is below the lower limit recommended by the Geotechnical Engineer, water shall be added until the moisture content is as specified; and when it is above the upper limit specified, the material shall be aerated by blading or other satisfactory methods until the moisture content is as specified.

H. After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted to not less than ninety (90) percent of maximum density in accordance with ASTM D 1557. Compaction shall be by equipment of such design that it will be able to compact the fill to specified density. When the City Representative, based on the recommendation of the Geotechnical Engineer, specifies a specific type of compaction equipment to be used, such equipment shall be used as specified.

I. Compaction of each layer shall be continuous over its entire area and the equipment shall make sufficient trips to ensure that the desired density has been obtained.

J. Field density tests shall be made by the Geotechnical Engineer. The compaction of each layer of fill shall be subject to testing. Where sheepfoot rollers are used, the soil may be disturbed to a depth of several inches. Density tests shall be taken in the compacted material below the disturbed surface. When tests indicate the density of any layer of fill or portion thereof is below the required ninety (90) percent density, the particular layer or portion shall be re-worked until the required density has been obtained.

K. When the City Representative, based on the recommendations of the Geotechnical Engineer, specifies compaction to other standards or to percentages other than ninety (90) percent, such specification, with respect to the particular items shall supersede these specifications.

L. The fill operation shall be continued in six (6.0) inches compacted layers, as specified above, until the fill has been brought to within 0.1 foot, plus or minus of the finished slopes and grades, as shown on the Plans. The finished surface of fill areas shall be graded or bladed to a smooth and uniform surface and no loose material shall be left on the surface.

M. No fill material shall be placed, spread, or compacted while it is frozen or thawing or during unfavorable weather conditions. When work is interrupted by weather conditions, fill operations shall not be resumed until the Geotechnical Engineer indicates that moisture content and density of previously placed fill are satisfactory.
3.5 Compaction:
   A. Compact areas not accessible to heavy equipment with pneumatic hand tampers.
   B. Compact areas within 5 feet of footings, foundations, and walls with pneumatic hand tampers.
   C. Comply with all requirements of the Project Representative and California Code of Regulations, Title 24, Part 2.

3.6 Tolerances:
   A. Rough grading: +0.1 foot.
   B. Under paved areas: +1.0 inch.
   C. General finish grading: +1.0 inch.

3.7 Field Quality Control:
   A. Perform field testing under provisions of Division 1.
   B. Perform testing and analysis of fill materials in accordance with ASTM D1557.
   C. Perform in-place compaction testing in accordance with ASTM D1557.
   D. If tests indicate work does not meet specified requirements, remove work, replace, and retest.
   E. Frequency of Tests: conduct moisture and density tests for every 200 cubic yards.

3.8 Observations and Testing:
   A. Except as required by the work of this Section, leave the entire graded portions of the site in the condition found at commencement of the work of this Section.
   B. The Contractor shall haul all surplus materials not needed or acceptable for reuse and legally dispose of such excess excavated material as required at the Contractor’s expense and no additional cost to the City.
   C. Contractor shall secure and provide all required laboratory testing to comply with his specification section.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation: Full compensation for furnishing labor, material, tools, equipment and incidentals for doing all work involved in Earthwork as shown on the Plans, as specified in these Technical Specifications and as directed by the City Representative, shall be included under the Contract bid items to which this work relates and no additional compensation will be allowed therefor.

END OF SECTION
02202

City of Arvin TECHNICAL PROVISIONS PART 2 - 10 OF 140

Project # 1902 – URBAN GREENING
SECTION 02230
CLEARING AND GRUBBING

PART 1 GENERAL

1.1 Summary:

A. Section Includes
Determining and protecting features to remain.
Site clearing, stripping, and grubbing.

B. Related Sections
Section 02232 - Selective Demolition
Section 02202 - Earthwork

1.2 Environmental Requirement:

A. Burning is not permitted.

B. Clearing or grubbing:
Do not perform during weather conditions which produce runoff from the site.
Resumption of clearing and grubbing will be determined by the City Representative.

1.3 Submittals:

A. Submit under provision of Section 01 33 00.

B. Submit plan for debris removal or disposal.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 Preparation:

A. Verify field measurements are as shown on drawings.

B. Protect elements surrounding the site from damage.

3.2 Clearing and Grubbing;

A. Confine site preparation work and equipment access to the construction areas shown on the Drawings.

B. Perform clearing and grubbing to areas to be prepared for construction.
3.3 Debris Disposal:

A. Remove all cleared and grubbed material from the prepared site areas.

B. Brush, branches and other approved material may be chipped and spread on designated area.

C. Dispose of excess soil material at designated area.

D. Dispose of trash, unchipped material, and debris at approved landfill sites.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation: Full compensation for furnishing labor, material, tools, equipment, and incidentals for doing all work involved in Clearing and Grubbing as shown on the Plans, as specified in these Technical Specifications and as directed by the City Representative, shall be considered as included in the lump sum contract price paid for clearing and grubbing, including furnishing all labor, materials, tools, equipment and incidentals for doing all work and no additional compensation will be allowed therefor.

END OF
SECTION 02230
PART 1 GENERAL

1.1 Related Documents:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other sections of Part I – General Specifications of these Specifications, apply to this Section.

1.2 Summary:

A. This Section includes the following:
   - Demolition and removal of selected portions of road sections or structures.
   - Demolition and removal of selected site elements.
   - Salvage of existing items to be reused or returned to the City Representative.

B. Related Sections include the following:
   - Section 02233 "Sawcut" for cutting and patching procedures.

1.3 Definitions:

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and salvaged for reinstallation.

B. Remove and Salvage: Detach item from existing construction, and deliver them to City Representative. Items to be salvaged shall be removed without damage to the item.

C. Remove and Salvage for Reinstallation: Detach item from existing construction, prepare for re-use, and securely store item until it is to be reinstalled at locations indicated. Items to be salvaged shall be removed without damage to the item.

D. Existing to Remain: Existing items of construction that are not to be removed.

1.4 Quality Assurance:

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with ANSI A10.6 and NFPA 241.

D. Pre-demolition Conference: Conduct conference at Project site to comply with requirements in "Sections 01 11 00 – Summary of Work and 01 11 10 – Project Coordination Review methods and procedures related to selective demolition."
1.5 Project Conditions:

A. Conditions existing at time of inspection for bidding purpose will be maintained by City Representative as far as practical.

C. Notify Project Representative of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify City Representative. The City will remove hazardous materials under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 Examination:

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be re-moved and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to the City Representative.

3.2 Utility Services and Mechanical/Electrical Systems:

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
   1. Cut off pipe, cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

3.3 Preparation:

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Comply with requirements for access and protection specified in the Part I General Specifications.

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

   1. Strengthen or add new supports when required during progress of selective demolition.

3.4 Selective Demolition, General:

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

   1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

   2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

   3. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

   4. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:

   Clean salvaged items.

   a. a. Items to be removed and salvaged for reinstallation shall be cleaned and repaired to functional condition adequate for intended reuse. Paint equipment to match new equipment.

   2. Pack or crate items after cleaning. Identify contents of containers.

   3. Store items in a secure area until delivery to the City Representative for reinstallation.

   4. Protect items from damage during transport and storage.

   5. Items salvaged to the City shall be held at the Project site for City Representative’s pick-up.

   6. Items to be reinstalled shall be installed in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by City Representative, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.
1. Items removed, salvaged, and reinstalled for the Contractor’s convenience shall be considered the same as items to be removed and salvaged for reinstallation.

3.5 Selective Demolition Procedures for Specific Materials:

A. Asphalt Concrete Pavement: Using power-driven saw, cut perimeter of area to be demolished, then break up and remove.

3.6 Disposal of Demolished Materials:

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the City’s property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in accordance with local regulations and in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn demolished materials.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation: Full compensation for conforming to the requirements of this Section shall be considered as being included in the total Contract price and no additional compensation shall be made therefor.

END OF
SECTION 02232
PART 1 GENERAL

1.1 Related Documents:

A. Plans and General Provisions of Contract, including General and Special Provisions and Technical Specification sections, apply to work of this section.

1.2 Description of Work:

A. Prior to excavation the Contractor shall sawcut all joint locations in order to provide a clean neat edge for pavement and concrete construction. Sawcut joints shall strictly conform to the alignments, widths, and depths indicated in the Plans. If edges are damaged during excavation, Contractor shall provide an additional sawcut as directed by the City in order to provide a clean neat edge for asphalt tie-in.

1.3 Quality Assurance:

A. Referenced Standards: Unless otherwise indicated, all referenced standards shall be the latest edition available at the time of bidding. Any requirements of these Specifications shall in no way invalidate the minimum requirements of the referenced standards. State of California, Department of Transportation (Caltrans) Standard Specifications dated May 2010.

Note: Provisions in the Caltrans Standard Specifications regarding measurement and payment do not apply to this work.

B. City Standards: Subdivision Standards for the City of Arvin dated October 2014.

1.4 Codes and Standards:

A. Environmental Compliance: Comply with applicable portions of local and State Environmental agency regulations pertaining to sawcut operations and material disposal. Including Regional Water Quality Control Board (RWQCB) and San Joaquin Valley Air Pollution Control District (SJVAPCD) requirements.

B. The noise created by the combined operation shall not exceed 86 dBA at a distance of 50 feet at right angles to the direction of travel.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 General:

A. The equipment used shall be capable of precisely following the sawcut alignments, widths, and depths indicated on the Plans and details.
B. Sawcuts for all joints including longitudinal joints will be required unless City approves an alternative.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation: Full compensation for conforming to the requirements of this article as shown on plans and as directed by Engineer, shall be considered as included in the lump sum contract price paid for miscellaneous demolition, including furnishing all labor, materials, tools, equipment and incidentals for doing all work and no additional compensation will be allowed therefor.

END OF
SECTION 02233
PART 1 GENERAL

1.1 Watering:

A. Watering consists of furnishing, hauling, and applying water required in the compaction of embankments, backfills, subgrade and base course, dust control, and other construction operations.

B. Developing water supply and applying water shall conform to the provisions of Section 17, “Watering,” of the Caltrans Standard Specifications, latest edition. No separate payment will be made for developing a water supply as provided for in Section 17.

C. The Contractor shall make arrangements with the water utility provider, Arvin Community Services District, to obtain a water meter and to connect to a fire hydrant. The Contractor shall be responsible for the cost of the water and is responsible for verifying water rates prior to bidding the project.

PART 2 PRODUCTS

2.1 Water:

A. Water used for construction shall be free of debris, organic matter and other objectionable substances.

PART 3 EXECUTION

3.1 Application:

A. Apply water for compaction and dust control by means of pressure-type distributors or a pipeline equipped with a spray system with nozzles that will insure a uniform application of water.

3.2 Equipment:

A. Provide all necessary pumping equipment, piping, meters, tanks, and water trucks. Water trucks shall be of at least 1,000-gallon capacity, equipped with a spray bar of ample capacity and designed to insure uniform and controlled application of water in the amount designated. When water is to be metered for measurement, use an approved metering device. Unless permitted otherwise by the City Representative or unless all the water is applied by means of pipeline, at least one (1) water truck with a minimum capacity of 1,000 gallons shall be available at all times. The release of the water truck will be subject to the approval of the City Representative.

3.3 Pre-wetting:

A. Pre-wetting the material in excavation areas prior to its removal for placement in embankments will be permitted when accomplished in an acceptable manner. If pre-wetting is done with a sprinkler system, the water shall be metered through approved devices located near the point of discharge. Provide adequate drilling equipment to
check the penetration of moisture for the full depth of the excavation. During pre-wetting, avoid excessive runoff and minimize water waste. Any required drying of pre-wetted embankment soils shall be done at no additional expense to the City Representative.

PART 4 MEASUREMENT AND PAYMENT

4.1 Payment: Full compensation for conforming to the requirements of this article as shown on plans and as directed by Engineer, shall be considered as included in the lump sum contract price paid for Mobilization, including furnishing all labor, materials, tools, equipment and incidentals for doing all work and no additional compensation will be allowed therefor.

END OF
SECTION 02234
PART 1 GENERAL

1.1 Summary:

A. Section Includes:
   Trenching.
   Backfill.

B. Related Documents and Sections:
   Section 02202 - Earthwork.
   CAL - OSHA – Standards and Requirements for Trench Bracing and Shoring.

1.2 References:

A. ASTM C33 - Concrete Aggregate.
B. ASTM C94 - Ready-Mixed Concrete.
D. ASTM D2922 - Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
E. ASTM D3017 - Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.3 Definitions:

A. Pipe Base: The trench area between the bottom of the trench and the bottom of the pipe. Extend full width and length of trench.
B. Pipe Zone: Area of trench between the top of the pipe base and 6 inches above the pipe, unless indicated otherwise. Extend full width and length of trench.
C. Backfill Zone: Area above Pipe Zone.
D. Relative Compaction: Field-measured dry weight expressed as a percent of maximum dry density of same soil determined in accordance with ASTM D1557.
E. Unclassified Excavation: Nature of materials to be encountered is not identified or described.
F. CAL – OSHA – Standards and Requirements for Trench Bracing and Shoring.

1.4 Description:

A. The work of this Section consists of cutting existing pavement, utility company coordination, removal and replacement of existing improvements, bypassing of existing
flows, trench excavation, dewatering, installation of pipe, trench backfill and compaction, temporary trench resurfacing, traffic control, barricading, and line acceptance testing.

Excavation for pipe shall be open trench unless otherwise specified or shown on the plans. However, should the Contractor elect to tunnel or jack any portion not so specified, he shall first obtain acceptance of the Engineer. Payment for such work will be made as though specified methods of construction had been used.

Excavation shall include the removal of all water and materials of any nature which interfere with the construction work. Removal of groundwater to a level below the structure subgrade will be necessary only when required by the plans or specifications.

For the purpose of shoring or bracing, a trench is defined as an excavation in which the depth is greater than the width of the bottom of the excavation.

Excavations for appurtenant structures, such as but not limited to manholes, vaults, valve boxes and thrust blocks, shall, for the purpose of shoring and bracing, be deemed to be in the category of trench excavation.

B. Trenching and backfilling shall have the acceptance of the City Representative. Work shall be done only under the general observation and, where required, the detailed inspection of the City Representative and/or utility purveyor's representative. Do not backfill until each specific location is approved.

1.5 Submittals:

A. Submit, under provisions of Section 01 33 00, certificates of compliance for pipe base and pipe zone materials.

B. Independent Testing and Laboratory Reports: Submit results of specified tests.

PART 2 PRODUCTS

2.1 Pipe Base and Pipe Zone:

A. Use sand conforming to ASTM C33 for PVC pipe and conduit less than 3-inch diameter.

B. Use crushed, partially crushed, or naturally occurring granular material, free from organic and inorganic debris, liquid limit less than 50, and plasticity index less than 12, that meets the following requirements for underground piping 3-inch or larger diameter, unless indicated otherwise:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand Equivalent</td>
<td>35 minimum</td>
</tr>
<tr>
<td>Passing 3/4-inch square sieve</td>
<td>100%</td>
</tr>
<tr>
<td>Passing 3/8-inch square sieve</td>
<td>50% - 75%</td>
</tr>
<tr>
<td>Passing No. 8 square sieve</td>
<td>5% - 15%</td>
</tr>
<tr>
<td>Passing No. 200 square sieve</td>
<td>0% - 3%</td>
</tr>
</tbody>
</table>

2.2 Backfill Material:

A. Native material free from organic and inorganic debris and of 3-inch maximum size.
B. Sand Cement Slurry Mixture: One sack cement mix with sand aggregate; maximum slump of 4 inches.

PART 3 EXECUTION

3.1 Examination:
   A. Verify that native excavated material to be reused as backfill is acceptable to the Project Representative.
   B. Identify lines and grades.

3.2 Removal of Water:
   A. At all times, provide and maintain means and devices to remove and dispose of water entering trench during preparations for and during pipe laying, and until backfill of the pipe is complete.

3.3 Trench Excavation:
   A. Trench excavation is unclassified. Excavate depth and width as shown or as directed. Allow for cover and pipe base under pipe. Remove loose matter.
   B. If Contractor elects to slope top of trench, the trench width shall be maintained at least 2 feet above top of pipe before sloping begins. Sloping, unless otherwise accepted by the City Representative, shall not be steeper than 1.5 H: 1V.
   C. Maximum and Minimum Width of Trench: For pipe, the minimum and maximum width of trench shall be as indicated on the Plans.

   If the maximum trench width is exceeded, the Contractor shall provide additional bedding, another type of bedding or a higher strength of pipe, as shown on the Plans or accepted by the Engineer, at no additional cost to the City.
   D. Cost to provide trench access shall be included in the contract price for pipe installation, with no additional compensation provided.

3.4 Removal of Surface Improvements
   A. Bituminous pavement, concrete pavement, curbs, curbs and gutters, sidewalks, or driveways removed in connection with construction shall be removed in accordance with Section 02230, "Clearing and Grubbing" and Section 02232, "Selective Demolition", of the Technical Specifications.

3.5 Pipe Laying
   A. General: Pipe shall be carefully inspected in the field before and after laying. If any cause for rejection is discovered in a pipe after it has been laid, it shall be subject to rejection and replacement. Any and all corrective work shall require direction in writing by the Engineer and shall be at no additional expense to the City.
   B. Pipe Laying: Pipe laying shall conform to the pipe installation specifications for the appropriate types of underground pipe construction to which this work relates and as included in these Technical Specifications.
3.6 **Pipe Base:**

A. Provide pipe base for supporting pipe for full width of trench. Unless shown otherwise, minimum depth of pipe base below pipe shall be 4 inches and not less than 3 inches under pipe bell.


C. If trench is excavated below required depth for pipe base, fill the excess depth with pipe base to proper subgrade. Place pipe base for full width of trench in layers not exceeding 6 inches deep and compact until material does not yield or move.

3.7 **Pipe Zone:**

A. Use pipe zone material except where concrete encasement or alternate backfill is indicated. Place material simultaneously on both sides of pipe in a manner approved by the City Representative. Lifts shall not exceed 6 inches.

B. Embedment (also bedding) material shall be defined as that material supporting, surrounding, and extending to one (1) foot above the top of pipe. Embedment material shall conform to "Pipe Zone" material as shown on the Plans. Where it becomes necessary to remove boulders or other interfering objects as subgrade for bedding, any void below such subgrade shall be filled with the bedding material designated in the Specifications. Where concrete is specified to cover the pipe, the top of the concrete shall be considered as the top of the embedment.

C. If soft, spongy, unstable, or other similar material is encountered upon which the embedment material or pipe is to be placed, this unsuitable material shall be removed to a depth ordered by the Engineer and replaced with embedment material compacted to a minimum of ninety (90) percent relative compaction. Additional bedding and excavation so ordered, over the amount required by the Plans and Specifications shall be included in the prices bid for the items involved, with no additional compensation allowed.

D. Bedding material shall first be placed so that the pipe is supported for the full length of the barrel with full bearing on the bottom segment of the pipe equal to a minimum of 0.4 times the outside diameter of the barrel.

E. Except where otherwise specified, bedding material shall conform with Section 19 of the Standard Specifications and consist of sand, gravel, or crushed aggregate accepted in writing by the Engineer.

3.8 **Backfill Zone:**

A. Place moisture-conditioned backfill material in lifts not exceeding 6 inches for hand operated mechanical compactors and not exceeding 8 inches for heavy equipment compactors.

B. Compact backfill in conformance to the City of Arvin, Subdivision Standard ST20 Improvement Standards, B1-A and B1-B.

C. Jetting will not be permitted.
D. Limits: Backfill shall be considered as starting one (1) foot above the pipe or conduit, or at the top of concrete bedding over the pipe or conduit. All material below this point shall be considered as bedding.

Where it becomes necessary to excavate beyond the limits of normal excavation lines in order to remove boulders or other interfering objects, the voids remaining after the removal of the boulders shall be backfilled with suitable material and compacted to a minimum of ninety (90) percent relative compaction.

The removal of all boulders or other interfering objects and the backfilling of voids left by such removals shall be at the sole expense of the Contractor and no additional compensation shall be provided. The total cost of such work shall be included in the contract prices for the various items of work.

Voids left by the removal of sheeting, piles and similar sheeting supports shall be immediately filled with clean sand which shall be jetted into place to assure dense and complete billing of the voids.

E. Proceeding: Except where the pipe must remain exposed for leakage tests and subject to the provisions herein, the Contractor shall proceed as soon as possible with backfilling operations. Care shall be exercised so that the conduit will not be damaged or displaced. The backfill above the concrete bedding shall not be placed nor sheeting pulled at least the minimum time after the placement provided by the optional classes of concrete designated in Section 90, "Concrete", of the Standard Specifications.

After the placing of backfill materials has been started, the Contractor shall proceed as soon as practicable with compaction.

F. Rocks and Other Material in Backfill: Rocks greater than three (3) inches in any dimension will not be permitted in backfill placed between one (1) foot above the top of any pipe or box and within one (1) foot of pavement subgrade.

Where rocks are included in the backfill, they shall be mixed with suitable excavated fine materials so as to eliminate voids.

Subject to the provision herein specified, the material obtained from project excavations may be used as backfill provided that all organic material, rubbish, debris, and other objectionable materials are first removed. However, broken Portland cement concrete and bituminous type pavement obtained from the project excavations will not be permitted in the backfill subject to the same limitations as rocks.

3.9 Public Safety and Access

A. Substantial steel plates with adequate trench bracing shall be used to bridge across trenches at street crossings where trench backfill and temporary patch have not been completed during regular working hours. Safe and convenient passage for pedestrians shall be provided. The Engineer may designate a passage to be provided at any point he deems necessary. Access to fire stations and fire hydrants shall be maintained at all times.

All costs associated with compliance with this Subsection shall be included in the contract prices. No additional compensation will be provided.
3.10 Existing Improvements

A. Utility companies' service laterals, water services and sewer servings are not shown on project plans. Contractor should allow for existing gas and water services for each lot shown. Utility companies will locate services and protect from injury by the Contractor and in the case of damage, they shall be restored by Contractor or by utility company personnel to the same type and quality of improvement without additional compensation.

Any improvements broken during construction shall be reconstructed by the Contractor, using the same kind of material and same dimensions as the original work, at his expense unless otherwise provided in the Specifications. In addition, any paving improvements shall be removed and replaced to a smooth edge or to the next joint or scoring line beyond the actual damaged or broken sections. All work shall match as nearly as possible the appearance and quality of the original improvements.

3.11 Field Quality Control:

A. Perform field testing under provisions of Section 01452.

B. If tests indicate work does not meet specified requirements, remove work, replace, and test.

C. Frequency of tests: Conduct nuclear gauge moisture and density testing in accordance with ASTM D2922 and ASTM D3017 procedures on every 200 feet of trench or 200 cubic yards of backfill material placed, whichever occurs sooner.

3.12 Completion Requirements:

A. Dispose of excess excavated material in fill area or in disposal area. Leave disposal area in a neat, free-draining condition.

PART 4 MEASUREMENT AND PAYMENT

4.1 Payment: Full compensation for conforming to the requirements of this Section shall be considered as being included under the Contract bid Item to which it relates, and no additional compensation shall be made therefor.

END OF SECTION
02302
SECTION 02530
AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 Summary:

A. Section Includes:
   Aggregate base.

B. Related Sections:
   Section 02202 - Earthwork.
   Section 03300 – Cast-in-Place Concrete

1.2 References:


B. California Test Method 216 - Relative Compaction of Untreated and Treated Soils and Aggregates.


D. California Test Method 229 - Method Test for Durability Index.

E. California Test Method 301 - Method Test for R-value Stabilometer.

F. Caltrans Standard Specifications Section 26 “Aggregate Base.”

1.3 Submittals:

A. Submit under provisions of Section 01 33 00.

B. Provide independent Testing Laboratory Reports that indicate material compliance with specified requirements.

PART 2 PRODUCTS

2.1 Materials:

A. Class 3 Aggregate Base (Decomposed Granite): Free from organic matter and other deleterious substances, capable of being compacted to form a firm, stable base; conforming to the following grading and quality requirements:

<table>
<thead>
<tr>
<th>Aggregate Grading Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size</td>
</tr>
<tr>
<td>1 inch</td>
</tr>
<tr>
<td>3/4 inch</td>
</tr>
<tr>
<td>No. 4</td>
</tr>
<tr>
<td>No. 30</td>
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### Quality Requirements

<table>
<thead>
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<th>Tests</th>
<th>Requirement</th>
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</thead>
<tbody>
<tr>
<td>Resistance (R-value) (CTM 301)</td>
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</tr>
<tr>
<td>Sand Equivalent (CTM 217) No. 30</td>
<td>18 min.</td>
</tr>
</tbody>
</table>

### PART 3 EXECUTION

#### 3.1 Examination:

A. Verify that subgrade is to the correct line, grade, and required compaction. Subgrade immediately prior to spreading base shall conform to the compaction and elevation tolerances specified and shall be free of loose or extraneous material.

B. Obtain acceptance of the City Representative prior to placing aggregate base.

C. Schedule work for favorable weather conditions.

#### 3.2 Constructing Aggregate Base Course:

A. Aggregate base shall be delivered as uniform mixture and spread free from pockets of coarse or fine material.

B. When aggregate base is spread, moisture content shall be sufficient to obtain the required compaction. Supplement with sprayed water as required to achieve compaction. Moisture shall be uniformly distributed throughout the material.

C. Maximum compacted thickness of any one layer shall not exceed 0.50 foot. Begin compaction of each layer as soon after spreading as practicable. Continue compaction to a minimum 95 percent relative compaction per ASTM D1557.

D. Each layer shall be placed and compacted to the specified density before a succeeding layer is placed.

E. Rolling shall commence at the outer edges and continue toward the center.

F. Minimum Contractor equipment:
   - Heavy-duty self-propelled grader, equipped with scarifier, broom, and not less than an 8-foot blade.
   - Ten-ton self-propelled roller or pneumatic-tired roller.

G. The finished surface shall be trimmed and shaped to produce smooth, uniform surfaces and slopes. The entire work area shall be left in a neat and presentable condition.

#### 3.3 Field Quality Control:

A. Perform field-testing under provisions of Section 01452.

B. Conduct compaction test on each lift for every 300 feet of roadbed length, minimum of two locations for project, in accordance with California Test Method 216.
PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation: Full compensation for furnishing labor, material, tools, equipment and incidentals for doing all work involved in Aggregate Base as shown on the Plans, as specified in these Technical Specifications and as directed by the City Representative, shall be included under the Contract bid items to which this work relates and no additional compensation will be allowed therefore.

END OF
SECTION 02530
PART 1 GENERAL

1.1 Related Documents

A. Drawings, general provisions of Contract, and Specifications apply to work of this section.

B. The plans shall govern if any conflicts exist between them and these specifications.

1.2 Summary

A. This Section includes provisions for the following items:
   1. Trees.
   2. Shrubs.
   3. Sod.
   4. Soil amendments.
   5. Initial maintenance of landscape materials.
   6. Ground cover, including gravel beds.

B. Related Sections: The following sections contain requirements that relate to this Section.
   1. Excavation, filling, and rough grading required to establish elevations shown on drawings is specified in Section 02202 Earthwork.
   2. Underground sprinkler system is specified Section 02950, Underground Irrigation System.

1.3 Quality Assurance

A. Subcontract landscape work to a single firm specializing in landscape work.

B. Source Quality Control:
   1. General: Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.
   2. Do not make substitutions. If specified landscape material is not obtainable, submit proof of non-availability to Landscape Architect, together with proposal for use of equivalent material.
   3. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.
   4. Trees, Shrubs and Plants: Provide trees, shrubs, and plants of quantity, size, genus, species, and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock". Provide healthy, vigorous stock, grown in recognized nursery in accordance with good horticultural practice and free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, or disfigurement.
5. Label each tree and shrub with securely attached waterproof tag bearing legible designation of botanical and common name.

6. Inspection: The Landscape Architect may inspect trees and shrubs either at place of growth or at site before planting, for compliance with requirements for genus, species, variety, size, and quality. Landscape Architect retains right to further inspect trees and shrubs for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from project site.

1.4 Submittals

A. Submit under provisions of Sections 01 33 00 and 01 33 01.

B. Plant and material data sheets

C. Maintenance Instructions: Typewritten instructions recommending procedures to be established by Owner for maintenance of landscape work for one full year. Submit prior to expiration of required maintenance period(s).

1.5 Delivery, Storage And Handling

A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

B. Trees and Shrubs: Provide freshly dug trees and shrubs. Do not prune prior to delivery unless otherwise approved by Landscape Architect. Do not bend or bind tie trees or shrubs in such manner as to damage bark, break branches, or destroy natural shape. Provide protective covering during delivery. Do not drop balled and burlapped stock during delivery.

C. Deliver trees and shrubs after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture.

D. Do not remove container grown stock from containers until planting time.

1.6 Job Conditions

A. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Landscape Architect before planting.

1.7 Sequencing And Scheduling

A. Planting Time: Proceed with, and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.

1. Plant or install materials during normal planting seasons for each type of plant material required.
2. Correlate planting with specified maintenance periods to provide maintenance from date of substantial completion.

B. Coordination with Sod: Plant trees and shrubs after final grades are established and prior to planting of sod, unless otherwise acceptable to Landscape Architect. If planting of trees and shrubs occurs after sod work, protect sod areas and promptly repair damage to sod resulting from planting operations.

1.8 Special Project Warranty

A. Warranty trees and shrubs, for a period of one year after date of notice of completion is approved by the City Council, against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond Landscape Installer's control.

B. Remove and replace trees, shrubs, or other plants found to be dead or in unhealthy condition during warranty period. Make replacements during growth season following end of warranty period. Replace trees and shrubs which are in doubtful condition at end of warranty period; unless, in opinion of Landscape Architect, it is advisable to extend warranty period for a full growing season.

1. Another warranty inspection will be conducted at end of extended warranty period, to determine acceptance or rejection. Only one replacement (per tree, shrub or plant) will be required at end of warranty period, except for losses or replacements due to failure to comply with specified requirements.

PART 2 PRODUCTS

2.1 Topsoil

A. Topsoil has been (or will be) stockpiled for re-use in landscape work. If quantity of stockpiled topsoil is insufficient, provide additional topsoil as required to complete landscape work.

B. Provide new topsoil that is fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 1 inch in any dimension, and other extraneous or toxic matter harmful to plant growth.

1. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site. Obtain topsoil only from naturally, well drained sites where topsoil occurs in a depth of not less than 4 inches. Do not obtain from bogs or marshes.

2.2 Soil Amendments

A. The following applies unless otherwise shown on the plans.

B. Sulfate of Ammonia: 21 percent N, 24 percent sulfur.

C. Gypsum: Agricultural grade, sulfate of lime.

D. Compost: Clean all green organic compost, derived from 100% plant sources.

E. Terra-C-Humate
F. Mulch: Organic mulch free from deleterious materials and suitable for top dressing of trees, shrubs, or plants and consisting of the following:
   1. Ground or shredded redwood bark humus, 1/8" - 3/4".

G. Commercial Fertilizer: Complete fertilizer of neutral character, with some elements derived from organic sources and containing following percentages of available plant nutrients:
   1. For trees and shrubs, provide fertilizer with not less than 10 percent total nitrogen, 6 percent available phosphoric acid and 8 percent soluble potash.
   2. For sod, provide fertilizer with percentage of nitrogen required to provide not less than 1 pound of actual nitrogen per 1,000 sq. ft. of turf area and not less than 4 percent phosphoric acid and 2 percent potassium. Provide nitrogen in a form that will be available to sod during initial period of growth; at least 50 percent of nitrogen to be organic form.

2.3 Plant Materials

A. Quality: Provide trees, shrubs, and other plants of size, genus, species, and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock".

B. Deciduous Trees: Provide trees of height and caliper scheduled or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed.
   1. Container grown deciduous trees will be acceptable, subject to specified limitations of ANSI Z60.1 for container stock.

C. Deciduous Shrubs: Provide shrubs of the height shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required.
   1. Container grown deciduous shrubs will be acceptable, subject to specified limitations for container grown stock.

D. Coniferous and Broadleafed Evergreens: Provide evergreens of sizes shown or listed. Dimensions indicate minimum spread for spreading and semi spreading type evergreens and height for other types, such as globe, dwarf, cone, pyramidal, broad upright, and columnar. Provide normal quality evergreens with well balanced form complying with requirements for other size relationships to the primary dimension shown.
   1. Container grown evergreens will be acceptable, subject to specified limitations for container grown stock.

2.4 Ground Cover

A. Provide plants established and well-rooted in removable containers or integral peat pots and with not less than minimum number and length of runners required by ANSI Z60.1 for the pot size shown or listed.

2.5 Miscellaneous Landscape Materials

A. Anti Desiccant: Emulsion type, film forming agent designed to permit transpiration, but retard excessive loss of moisture from plants. Deliver in manufacturer's fully identified containers and mix in accordance with manufacturer's instructions.
B. Stakes and Guys: Provide stakes of lodgepole pine, free of knot holes and other defects. Provide cinch-tie tree ties of UV resistant vinyl material. Cut top of poles off 3 inches above top tie after wrapped around tree.

PART 3 EXECUTION

3.1 Preparation General

A. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas before start of planting work. Make minor adjustments as may be required.

3.2 Preparation Of Planting Soil

A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.

B. Mix specified soil amendments and fertilizers with topsoil at rates specified. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.
   1. "Schedule of Planting Soil Mixture Requirements" is attached at end of this section.

C. For pit and trench type backfill, mix planting soil prior to backfilling, and stockpile at site.

D. For planting beds and lawns, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.
   1. Mix Gypsum with dry soil prior to mixing of fertilizer.
   2. Prevent Gypsum from contacting roots of acid loving plants.
   3. Apply phosphoric acid fertilizer (other than that constituting a portion of complete fertilizers) directly to subgrade before applying planting soil and tilling.

3.3 Preparation For Planting Lawns

A. Till subgrade of lawn areas to a minimum depth of 8 inches. Remove stones measuring over 1 inch in any dimension. Remove sticks, roots, rubbish, and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.

B. Preparation of Unchanged Grades: Where lawns are to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for lawn planting as follows: Till to a depth of not less than 12 inches. Apply soil amendments and initial fertilizers as specified. Remove high areas and fill in depressions. Till soil to a homogenous mixture of fine texture, free of lumps, clods, stones, roots and other extraneous matter.
   1. Apply specified commercial fertilizer at rates specified and thoroughly mix into upper 2 inches of topsoil. Delay application of fertilizer if lawn planting will not follow within a few days.
      a. "Schedule of Planting Soil Mixture Requirements" indicating required rate of fertilizer application, is attached at end of this section.

C. Fine grade lawn areas to smooth, even surface with loose, uniformly fine texture. Roll, rake, and drag lawn areas, remove ridges and fill depressions, as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.
D. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.

E. Restore lawn areas to specified condition, if eroded or otherwise disturbed, after fine grading and prior to planting.

3.4 Preparation Of Planting Beds

A. Till beds not less than 12 inches deep and mix with specified soil amendments and fertilizers.

3.5 Excavation For Trees And Shrubs

A. Excavate pits, beds, and trenches as indicated and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.

1. Make excavations at least half again as wide as the ball diameter and equal to the ball depth, plus following allowance for setting of ball on a layer of compacted backfill:
   a. Allow for setting layer of planting soil mixture as shown on drawings.

B. Dispose of subsoil removed from planting excavations. Do not mix with planting soil or use as backfill.

C. Fill excavations for trees and shrubs with water and allow water to percolate out prior to planting.

3.6 Planting Trees And Shrubs

A. Set rootball on a layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Remove burlap from sides of balls; retain on bottoms. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.

B. Dish top of backfill at trees to create mulch pit.

C. Mulch pits, trenches, and planted areas. Provide not less than following thickness of mulch, and work into top of backfill and finish level with adjacent finish grades.

1. Provide 2 inch thickness of mulch.

D. Apply anti desiccant, using power spray, to provide an adequate film over trunks, branches, stems, twigs and foliage.

1. If deciduous trees or shrubs are moved when in full leaf, spray with anti desiccant at nursery before moving and spray again 2 weeks after planting.

E. Prune, thin out, and shape trees and shrubs in accordance with standard horticultural practice. Prune trees to retain required height and spread.

F. Unless otherwise directed by Landscape Architect, do not cut tree leaders, and remove only injured or dead branches from flowering trees, if any. Prune shrubs to retain natural character.
G. Remove and replace excessively pruned or misformed stock resulting from improper pruning.

H. Stake and tie trees immediately after planting, as indicated.

I. Mulch areas between trees and shrubs in planters; place not less than 2” thick.

3.7 Placing New Sod

A. General: The installation contractor shall furnish all labor, material and equipment required to complete the work described herein, in strict accordance with the drawings and/or terms of the contract.

B. Grading: All previously established grades shall be maintained in conformance with the drawings and/or applicable specifications.

C. Time Limitations: Turfgrass sod shall be transplanted/installed within a period of 24 hours following harvesting, unless a suitable preservation method is approved prior to delivery. Turfgrass sod not transplanted within this period shall be inspected and approved by the inspecting officer or his representative prior to its installation.

D. Transplanting:
   1. Moistening the Soil: During periods of higher than optimal temperature for the species being specified, and after all unevenness in the soil surface has been corrected, the soil shall be lightly moistened immediately prior to installation of the turfgrass sod.
   2. Starter Strip: The first row of turfgrass sod shall be laid in a straight line, with subsequent rows placed parallel to and tightly against each other. Lateral joints shall be staggered to promote more uniform growth and strength. Care shall be exercised to insure that the pieces are not stretched or overlapped and that all joints are butted tightly to prevent voids that would cause air drying of the roots.
   3. Sloping Surfaces: On 3:1 or greater slopes, traditional size (1 sq yd / 1 sq m) turfgrass sod shall be laid across the angle of the slope (perpendicular), with staggered joints and secured by tamping, pegging, stapling or other approved methods of temporarily securing each piece. Large-roll turfgrass sod shall be laid in the direction of the slope, with temporary securing being at the discretion of the installation contractor.
   4. Swales and Intermittent Waterways: The installation of turfgrass sod within drainways or intermittent waterways shall be determined after considering maximum channel velocities for storms of a designated intensity. Traditional size turfgrass sod shall be laid perpendicular to the direction of flow and pegged to resist washout during the establishment period, while large-roll pieces shall be laid in the direction of the flow, with temporary securing being at the discretion of the installation contractor.
   5. Watering and Rolling: The installation contractor shall water the turfgrass sod immediately after transplanting to prevent drying. As sodding is completed in any one section, the entire area shall be lightly rolled. It shall then be thoroughly watered to a depth sufficient to ensure the underside of the new sod pad and soil immediately below the pad are thoroughly wet. The general contractor shall be responsible for having adequate water available at the site prior to and during installation.
3.8 Planting Ground Cover

A. Space ground cover plants as indicated or scheduled.

B. Dig holes large enough to allow for spreading of roots and backfill with planting soil. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water. Water thoroughly after planting, taking care not to cover crowns of plants with wet soils.

C. Mulch areas between ground cover plants; place not less than 2 inches thick.

3.9 Maintenance

A. Begin maintenance immediately after planting.

B. Maintain trees, shrubs, and other plants by pruning, cultivating, and weeding as required for healthy growth. Restore planting saucers. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and disease.

3.10 Break-In Period

A. The Contractor shall notify the Engineer, in writing, when the irrigation system is completely operational, and when all new plantings are completed. At such time, the Contractor shall be required to monitor the landscaping improvements and make minor adjustments, and replace damaged, dead or dying plants, as necessary, for a period of 90 days following such written notification. The Contractor shall schedule a turnover and training meeting with the Engineer and Maintenance Division to take place on the 90th day or as soon after the 90th day as scheduled by the Contractor. At said meeting, the Contractor shall instruct the City Representatives on the proper operation of the system(s), and shall demonstrate that it is functioning properly. The Contractor shall repair and or replace any components that the City Representatives observe to be malfunctioning or in disrepair at no additional cost to the City.

B. If the turnover meeting occurs prior to the completion of construction, the Contractor shall be responsible for continued maintenance and minor adjustments until such time as a notice of completion is filed by the City.

C. A notice of completion will not be filed by the city until the 90 day break-in period is completed.

A. Measurement and

3.11 Cleanup And Protection

A. During landscape work, keep pavements clean and work area in an orderly condition.

B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.
PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation

Full compensation for furnishing labor, material, tools, equipment and incidentals for doing all work involved in Landscape Work as shown on the Plans, as specified in these Technical Specifications and as directed by the Owner’s Representative, shall be included under the Contract items to which this work relates and no additional compensation will be allowed therefor.

END OF SECTION
PART 1 GENERAL

1.1 Related Documents
   A. Drawings, general provisions of Contract, and Specifications apply to work of this section.

1.2 Description Of Work
   A. Extent of underground irrigation system is indicated on drawings.
   B. Refer to plans for specifications for irrigation systems and low voltage control systems.

1.3 REFERENCES
   A. City of Arvin Standards
   B. City of Arvin Quality Assurance Plan (QAP)
   C. Project Specifications and Drawings

1.4 Submittals
   A. Submit under provisions of Sections 01 33 00 and 01 33 01.
   B. Product Data: Submit manufacturer's technical data and installation instructions for irrigation system components including the following:
      1. Sprinkler heads and fittings
      2. Water pipe and fittings
      3. Valve boxes
      4. Control components and timers
      5. Control wiring and conduit
      6. Backflow preventer(s)

PART 2 PRODUCTS

2.1 Manufacturer
   A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to the following:
      1. Hunter Industries.
      2. Rainbird.
      3. Other manufacturers as indicated on drawings.

2.2 Materials
   A. Pressure Pipe: Comply with following:
      1. PVC plastic pipe, ASTM D 1785, PVC 1120, Schedule 40, 160 psig.
2. Galvanized steel pipe, ASTM A 120, Schedule 40.

B. Circuit Pipe (downstream from circuit valves): Comply with following:
   1. PVC plastic pipe, ASTM D 1785, PVC 1120, Schedule 40, 160 psig.

C. Pipe Fittings: Comply with following:
   1. For PVC plastic pipe, ASTM D 2466 socket fittings.
   2. For galvanized steel pipe, ANSI B16.3 galvanized malleable iron screwed fittings.

D. Valves: Manufacturer's standard, of type and size indicated, and as follows:

E. Backflow Preventer: Manufacturer's standard reduced pressure type, as indicated on drawings.

F. Sprinkler Heads: Manufacturer's standard plastic bodied unit designed to provide uniform coverage over entire area of spray shown on drawings at available water pressure, as follows:
   1. Bubbler: Pressure compensating full circle, trickle pattern bubblers.
   2. Pressure Compensating Emitter: Low flow emitters for point source watering.
   3. Pop-up Rotary: Adjustable pattern with screw type flow adjustment and stainless steel retraction spring.

H. Valve Box: Manufacturer's standard plastic unit, with labeled cover and lock down torx bolts, for each group of valves.

I. Drainage Backfill: Cleaned gravel or crushed stone.

J. Joining Material: ASTM F656 primer and ASTM D 2564 solvent cement.

2.3 Automatic Control System

A. General: Furnish low voltage system manufactured expressly for control of automatic circuit valves of underground irrigation systems. Provide unit of capacity to suit number of circuits required.


C. Transformer: Internal type to convert building service voltage to control voltage of 24 volts.

D. Circuit Control: Each circuit variable from approximately 1 to 99 minutes. Include switch for manual or automatic operation of each circuit.

E. Timing Device: Adjustable dual program, solid state electronic 24 hour clock to operate any time of day and skip any day in a 7 or 14 day period. Equip with battery back up to maintain time keeping during power outages.
   1. Allow for manual or semi automatic operation without disturbing preset automatic operation.
F. ET Manager Cartridge: Measures 4 key components of ET: solar radiation, relative humidity, wind and temperature, as well as effective rainfall.

PART 3 EXECUTION

3.1 System Design

A. Location of Heads: Design location is approximate. Make minor adjustments as necessary to avoid plantings and other obstructions, such as sign standards and light poles.

B. Layout may be modified, if necessary to obtain coverage, to suit manufacturer's standard heads. Do not decrease number of heads indicated unless otherwise acceptable to Landscape Architect.

C. Minimum Water Coverage:
   1. Head to head at spray heads.

D. Minor adjustments that differ from the layout shown on the drawings shall be performed at the cost of the contractor and at no additional cost to the City.

3.2 Trenching And Backfilling

A. General: Excavate straight and true with bottom uniformly sloped to low points.

B. Minimum Cover: Provide following minimum cover over top of installed piping:
   1. Pressure piping, 18".
   2. Circuit Piping: 12".

C. Backfill: Backfill with clean material from excavation. Remove organic material as well as rocks and debris larger than 1" diameter. Place acceptable backfill material in 6" lifts, compacting each lift.

3.3 Installation

A. General: Comply with requirements of authorities having jurisdiction.

B. Connection to Main: Connect to stubbed piping in location indicated.
   1. Connect to stub with union.

C. Circuit Valves: Install in valve box, arranged for easy adjustment and removal, maximum 3 valves per box.
   1. Provide union on downstream side.
   2. Adjust automatic control valves to provide flow rate of rated operating pressure required for each sprinkler circuit.
   3. Place 6 inch thick layer of drainage fill below valve boxes.

D. Piping: Lay pipe on solid subbase, uniformly sloped without humps or depressions.
1. Install PVC pipe in dry weather when temperature is above 40 deg.F (4 deg.C) in strict accordance with manufacturer's instructions. Allow joints to cure at least 24 hours at temperature above 40 deg.F (4 deg.C) before testing, unless otherwise recommended by manufacturer.

E. Sprinkler Heads: Flush circuit lines with full head of water and install heads after hydrostatic test is completed.
   1. Install pop-up heads at manufacturer's recommended height.
   2. Locate part circle heads to maintain a minimum distance of 6 inches from walls and 2 inches from other boundaries, unless otherwise indicated.

F. Dielectric Protection: Use dielectric fittings at connection where pipes of dissimilar metal are joined.

### 3.4 Testing

A. Notify Engineer when testing will be performed.

B. Hydrostatic Test: Test water piping and valves, before backfilling trenches, to a hydrostatic pressure of not less than 75 psi for two hours. Piping may be tested in sections to expedite work. Remove and repair piping, connections, valves which do not pass hydrostatic testing.

C. Operational Testing: Perform operational testing after hydrostatic testing is completed, backfill is in place, and emitters and sprinkler heads adjusted to final position.
   1. Demonstrate to Landscape Architect that system meets coverage requirements and that automatic controls function properly.
   2. Coverage requirements are based on operation of one circuit at a time.

### 3.5 Adjusting

A. Provide additional backfill and compaction for excavations performed as work of this section which have settled.

### 3.6 BREAK-IN PERIOD

A. The Contractor shall notify the Engineer, in writing, when the irrigation system is completely operational, and when all new plantings are completed. At such time, the Contractor shall be required to monitor the irrigation system and make minor adjustments, and make repairs to damaged or malfunctioning components of the system, as necessary, for a period of 90 days following such written notification. The Contractor shall schedule a turnover and training meeting with the Engineer and Maintenance Division to take place on the 90th day or as soon after the 90th day as scheduled by the Contractor. At said meeting, the Contractor shall instruct the City Representatives on the proper operation of the system(s), and shall demonstrate that it is functioning properly. The Contractor shall repair and or replace any components that the City Representatives observe to be malfunctioning or in disrepair at no additional cost to the City.

B. If the turnover meeting occurs prior to the completion of construction, the Contractor shall be responsible for continued maintenance and minor adjustments until such time as a notice of completion is filed by the City.

C. A notice of completion will not be filed by the city until the 90 day break-in period is completed.
PART 4 MEASUREMENT AND PAYMENT

4.1 COMPENSATION

Full compensation for furnishing labor, materials, tools, equipment, and incidentals for doing all work involved in Irrigation Systems as shown on the Plans, as specified in these Technical Specifications and as directed by the City, shall be included under the Contract items per each to which this work relates and no additional compensation will be allowed therefor.

END OF SECTION
PART 1 GENERAL

1.1 Summary:

A. Section Includes:
   - Formwork for cast-in-place concrete, with shoring, bracing, and anchorage.
   - Openings for other work.
   - Form accessories.
   - Form stripping.

B. Related Documents and Sections
   - Section 03200 - Concrete Reinforcement.
   - Section 03300 - Cast-In-Place Concrete.
   - Section 03305 – Concrete Testing

1.2 References:


1.3 Quality Assurance:

A. Formwork shall conform with ACI 347, unless otherwise specified.

1.4 Delivery, Storage and Handling:

A. Store products subject to damage by dirt and moisture in a clean, dry location, off the ground and suitably protected.

1.5 Coordination:

A. Coordinate the design, construction, and installation of concrete formwork with the requirements for openings, sleeves, anchors, ties, inserts and other embedded items.

PART 2 PRODUCTS

2.1 Materials:

A. Form materials shall be new and undamaged at start of work.

B. Use flexible spring steel forms or laminated boards to form radius bends.

C. Form Lumber: Douglas Fir, Construction Grade, No. 2 or better, S1S2E.
2.2 Earth Forms:

A. Where accepted by Owner’s Representative, vertical excavated surfaces may be used for forms for pit slab(s), provided that the earth will stand without caving and that suitable provisions are taken to prevent raveling of top edges or sloughing of loose materials from the walls of the excavation.

B. Where earth forms are permitted, clear dimensions as indicated shall be maintained and any over excavation shall be filled monolithically with concrete.

C. Construct wood edge strips at top sides of excavations.

2.3 Form Accessories:

A. Accessories which will be wholly or partially embedded in concrete, such as ties and hangers, shall be a commercially manufactured type, of metal; wire will not be acceptable.

B. The portion remaining in the concrete shall leave no metal within one and one half (1-1/2) inch of concrete face and no fractures, spalls, depressions, or other surface disfigurations greater that 3/4 inch in diameter.

C. Spreader cones on ties shall not exceed one inch in diameter.

2.4 Form Sealer:

A. Manufacturers
   Sonneborn Building Products, Inc., "Form Saver."
   Grace Construction Materials "Form Fill."
   Burke "Form Sealer" (also known as "Kwik Koat Form Coating").

B. Type: Form sealer shall eliminate grain raise as a result of moisture and shall not interfere with color, bond, or subsequent treatment of concrete surface.

2.5 Form-Release Agents:

A. For Exposed Concrete to Receive Paint or Other Coatings: Chemically active type producing water insoluble soaps. Release agents shall contain no petroleum solvents such as creosote, paraffin, wax or diesel oils.

B. For Unexposed Concrete: Any type that will not interfere with bond of applied finishes.

PART 3 EXECUTION

3.1 Formwork:

A. All concrete placement shall be contained by constructed forms or stable earth forms.

B. Design, construct, and brace formwork and temporary falsework to safely support concrete and safely hold personnel during construction operations.
C. Construct forms of sufficient strength and rigidity to produce finished concrete of the precise size, shape, and location indicated, within the specified tolerances. Form assembly shall permit removal in proper sequence without damage to concrete.

D. Arrange forms to permit single placement of exposed areas and panels without joints between adjacent forming materials in the same plane.

E. Construct forms for concrete full height and width between construction joints in concrete surface.

F. Construct forms no higher than 12 inches above the top of a placement or construction joint.

G. Construction Joints
   Form in accordance with requirements of Section 03300.
   Provide a surfaced strip where construction joints intersect exposed surfaces; faces to provide straight lines at joints. Prior to subsequent placement, remove strip and tighten forms.
   Construction joints shall show no overlapping or offsetting of concrete surfaces and shall, as closely as possible, present the same appearance as butted plywood joints.
   Joints in a continuous line shall be straight and true.

H. Provide cleanouts as required to permit inspection and thorough cleaning of loose dirt, debris, and waste material. Cleanouts shall not be apparent on concrete surfaces exposed to view in the finished Work.

I. Whenever concrete bases or foundations are to be provided for equipment furnished as part of the Work of other Sections, verify dimensions for the equipment to be furnished before concrete is placed.

J. For surfaces not exposed to view in the finished Work, forms shall be lumber, form plywood, or any other suitable material.

K. Formwork shall be clean and free of debris when concrete is placed.

L. Forms shall be sufficiently tight to prevent leakage of water and mortar.

M. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only.

N. Locate temporary openings on forms at inconspicuous locations.

O. Provide openings in formwork to accommodate work of other Sections. Accurately place and securely support items built into forms.

3.2 Tolerances:

A. Construct formwork to tolerances specified in ACI 347, except that anchor bolt setting tolerances shall be in conformance with AISC Code of Standard Practice, Section 7.5.

B. Where tighter tolerances are required to accommodate detention equipment or other items specified in other sections, construct formwork to the most restrictive tolerance.
3.3 Preparation of Forms:
A. Treat contact surface of plywood and lumber forms with a form sealer in accordance with the manufacturer's printed instructions.
B. Clean surfaces and reseal before each use to ensure undamaged concrete.
C. Do not use form oil.

3.4 Stripping of Forms:
A. Strip forms using methods which will not damage concrete.
B. Do not remove forms until concrete has attained sufficient strength to support its own weight and construction live loads to be placed thereon without damage to the structure, but not before minimum time as follows:
   Footings, Curbs, Walks, and Paving: Side forms may be removed 24 hours after concrete is placed.
   Slabs: 10 days

3.5 Re-Use of Forms:
A. Re-use of forming materials shall be subject to the approval of the Owner's Representative, provided the material is structurally sound, free of defects and blemishes. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. In no case shall wood forming materials be used more than 4 times.
B. Clean and repair surfaces of forms to be re-used in the work. Apply new form coating compound as specified for new formwork.
C. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation: Full compensation for furnishing labor, material, tools, equipment and incidentals for doing all work involved in Concrete Formwork as shown on the Plans, as specified in these Technical Specifications and as directed by the Owner's Representative, shall be included under the Contract bid items to which this work relates and no additional compensation will be allowed therefore.

END OF
SECTION 03100
PART 1 GENERAL

1.1 Summary:
   A. Section Includes
      Steel reinforcing steel bars, steel wire fabric, and accessories for concrete and unit
      masonry.
   B. Related Sections
      Section 03100 - Concrete Formwork.
      Section 03300 - Cast-in-Place Concrete.
      Section 03305 - Concrete Testing.

1.2 References:
   A. ACI 315 - Details and Detailing of Reinforced Concrete.
   B. ACI 318 - Building Code Requirements for Reinforced Concrete.
   C. ASTM International (ASTM)
      ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
      ASTM A706 - Low-Alloy Steel Deformed Bars for Concrete Reinforcement.

1.3 Submittals:
   A. Submit under provisions of Section 01 33 00.
   B. Shop Drawings: Indicate bending and placing details of reinforcement; bar sizes,
      spacings, locations, and quantities of reinforcing steel and wire fabric; bending and
      cutting schedules; and supporting and spacing devices.
   C. Manufacturer's Certificate: Certify that products meet or exceed specified
      requirements.
   D. Submit manufacturers' installation instructions.
   E. Submit certified copies of mill test report of reinforcement materials analysis.

1.4 Quality Assurance:
   A. Detailing, fabricating, and spacing of reinforcement shall be in conformance with ACI
      315 and ACI 318, unless otherwise indicated.
   B. Tests: Under provisions of Section 01452.
   C. Weld reinforcement in accordance with AWS D1.4. Do not weld reinforcement unless
      specifically indicated or directed by Owner's Representative.
D. Perform Work in accordance with ACI 301.

E. Owner’s Representative will inspect reinforcement.

1.5 Delivery, Storage, and Handling:

A. Deliver reinforcing steel from the mill in securely tied bundles, each bundle limited to one size and grade of material. Plastic or metal tags in an exposed position on each bundle shall identify the mill, the melt or heat number, and the grade and size of material. Maintain identification of steel after bundles are broken.

B. After fabrication, bundle reinforcing steel and tag for identification at the site. Tags shall identify the steel by the reinforcement item marking indicated on the reviewed Shop Drawings and the quantity of such item contained in the bundle.

C. Segregate to maintain identification after bundles are broken.

D. Store off the ground, protected from the elements and contaminants, which could adversely affect bond.

1.6 Coordination:

A. Coordinate reinforcement with placement of formwork, anchor bolt locations, anchors, inserts, conduit, sleeves, and other items required to be cast in concrete. Ensure reinforcement will not interfere with the placement of such items, formed openings and other Work.

PART 2 PRODUCTS

2.1 Reinforcement:

A. Reinforcing Bars

Non-Welded Bars: ASTM A615, deformed billet steel bars, plain finish, unless indicated otherwise.

Grade 60.

2.2 Accessory Materials:

A. Wire for Ties, Stirrups, and Spiral Reinforcement: ASTM A82, minimum 16 gage.

B. Splice Sleeves:

Acceptable Manufacturers:

a. Splice Sleeve North America; NMB Splice Sleeve.


Description: Steel splice sleeves shall conform to requirements of ACI 318 and CBC, Chapter 19A, for mechanically spliced reinforcing. Each splice sleeve shall be identified with the size, type, and manufacturer’s identification imprinted on the sleeve.

C. Chairs, Bolsters, Spacers, Bar Supports, and Other Accessories
Conform to requirements of ACI 315; size and shape for strength and support of reinforcement during concrete placement conditions.

Where portion of accessories will be within 1/2 inch of concrete surfaces exposed to the weather in the finished Work, such accessories shall be made of stainless steel.

Use wire bar type support complying with CRSI recommendations, unless indicated otherwise.

For slabs on grade, use supports with sand plates or horizontal runners where wetted base materials will not support chair legs.

For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are hot-dip galvanized, or plastic or stainless steel protected.

Over vapor barriers or waterproof membranes use load-bearing bottom pads or precast concrete chairs to prevent penetration of the membrane.

2.3 Fabrication:

A. Fabrication of reinforcement items shall proceed only after review of bar lists and Shop Drawings. Each unit of reinforcement shall be fabricated to conform to the reviewed bar lists and shop drawings.

B. Reinforcing steel shall be bent cold and shall not be straightened or rebent in a manner that will damage the material.

C. Fabricate concrete reinforcing in accordance with ACI 318 and CBC, Chapter 19A.

D. Locate reinforcing splices not indicated on Drawings, at point of minimum stress as approved.

PART 3 EXECUTION

3.1 Placement:

A. At time of concrete placement, reinforcement shall be free of coatings that could adversely affect the bond with concrete.

B. Reinforcement shall be supported and fastened together to prevent displacement by construction loads or by the placement of concrete beyond the tolerances specified in ACI 301. Sizes and dimensions of supports shall be as required to position the steel as indicated on the reviewed Shop Drawings and in conformance with the minimum concrete protective covering requirements of ACI 301.

C. Furnish reinforcing bars full length, to the extent practicable. Splices will be permitted only where indicated on the Drawings, or reviewed Shop Drawings.

D. Sleeved Splices: Install splice sleeves in accordance with manufacturer’s instructions. Splice sleeves will be permitted only where indicated in the Drawings.

E. Other Splices in Reinforcement: Lapped ends of bars may be placed in contact and securely wired or may be separated sufficiently to permit the embedment of the entire surface of each bar in concrete.
Stagger splices in adjacent bars.
Lap bars as indicated, but no less than 24 inches.

F. Obstructions: Where conduit, pipes, inserts, sleeves, or other items interfere with the placement of reinforcement, notify the Owner's Representative and obtain acceptance of procedure before placement of concrete is started.

G. Concrete Cover: Indicated on Drawings.

H. Place, support and secure reinforcement against displacement. Do not deviate from required position.

I. Misplaced Reinforcing
If reinforcing bars are found to be misplaced after concrete has been placed, immediately notify the Owner's Representative and make no correction and cutting without Owner's Representative review and recommendations.

Misplaced bars shall not be bent.
Perform redesign alterations, corrections, or replacement of concrete or reinforcing required because of misplaced bars.

J. Do not displace or damage vapor barrier.

K. Accommodate placement of formed openings.

L. Dowels shall be tied securely in place before concrete is deposited. Bending of dowels subsequent to concrete placement is not permitted. Dowels extended for future construction shall be protected from weather exposure, where shown on Drawings.

3.2 Maintenance of Reinforcing:

A. Continuously inspect and maintain reinforcement in proper position during concrete operations.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation: Full compensation for furnishing labor, material, tools, equipment and incidentals for doing all work involved in Concrete Reinforcement as shown on the Plans, as specified in these Technical Specifications and as directed by the Owner's Representative, shall be included under the Contract bid items to which this work relates and no additional compensation will be allowed therefor.

END OF
SECTION 03200
SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 Summary:

A. Section Includes
   Structural concrete for building and structure elements, concrete floors exterior concrete flatwork.
   Expansion and contraction joint devices associated with concrete work.
   Equipment pads, light pole base, thrust blocks, and other items indicated.

B. Related Sections
   Section 01452 – Testing Services.
   Section 03100 - Concrete Formwork: Formwork and accessories.
   Section 03200 - Concrete Reinforcement.
   Section 03305 - Concrete Testing.

1.2 References:

A. American Concrete Institute (ACI)
   ACI 301 - Structural Concrete for Buildings.
   ACI 302 - Guide for Concrete Floor and Slab Construction.
   ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
   ACI 305R - Hot Weather Concreting.
   ACI 306R - Cold Weather Concreting.
   ACI 308 - Standard Practice for Curing Concrete.
   ACI 318 – Building Code Requirements for Reinforced Concrete.

B. American National Standards Institute (ANSI)
   ANSI/ASTM D994 - Preformed Expansion Joint Filler for Concrete (Bituminous Type).
   ANSI/ASTM D1190 - Concrete Joint Sealer, Hot-Poured Elastic Type.
   ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
   ANSI/ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

C. ASTM International (ASTM)
   ASTM B221 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
   ASTM C33 - Concrete Aggregates.
1.3 Regulatory Requirements:

A. California Code of Regulations (CCR)
   California Building Code (CBC), Title 24, Part 2.

1.4 Definitions:

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

1.5 Submittals:

A. Submit under provisions of Section 01 33 00.

B. Product Data: Provide data on products and materials specified.

C. Shop Drawings: Indicate locations of proposed construction and control joints, prior to placement.

D. Samples: Submit two, 6-inch long samples of expansion/contraction joint and control joint materials.

E. Certificates of Compliance: Prior to incorporation in construction, submit manufacturer's Certificate that specific products proposed for use meet or exceed specified requirements.

F. Mix Designs.

Where fly ash is proposed for use in a mix:

a. Submit certified mix design without fly ash together with a mix design with fly ash for comparison.

b. Submit test results on three cylinders for each test; aged, prepared, and cured in accordance with ASTM C192; test at 7 and 28 days in accordance with ASTM C39. The test cylinders shall have been
prepared from a batch of the proposed design mix with fly ash. Where the 28-day tests do not meet specified strength requirements, the design mix will not be acceptable.

G. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent Work.

1.6 Quality Assurance:

A. Conform to CBC, California Building Code.

B. Perform Work in accordance with ACI 301. Maintain one copy of document on site.

C. Acquire cement and aggregate from same source for all work.

D. Conform to ACI 305R when concreting during hot weather.

E. Conform to ACI 306R when concreting during cold weather.

F. Allowable Tolerances: Deviation from plumb or level shall not exceed 1/8 inch within 10 feet in any direction, as determined with a 10-foot straight edge.

1.7 Product Delivery, Storage, and Handling

A. Deliver, store, and handle packaged materials in the manufacturer's original, sealed containers, each clearly identified with the manufacturer's name, and name and type of product.

B. Store materials subject to damage by dirt and moisture in a clean, dry location, off the ground and suitably protected.

C. Store coarse and fine aggregates in separate, covered bins.

D. Store bulk cement in covered bins.

1.8 Job Conditions:

A. Environmental Requirements for Placing Concrete
   Hot Weather: ACI 305.
   Cold Weather: ACI 306.

   Do not place concrete during precipitation, unless adequate protection is provided.

1.9 Coordination:

A. When required by Local Agency / Building Official Representative, provide a Concrete Placement Checklist in form approved by Local Agency / Building Official Representative. Checklist to indicate items of work and must be signed by Contractor and Local Agency / Building Official Representative prior to placement of concrete.

B. Coordinate work under provisions of Section 01140.

C. Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.
D. Coordinate the installation of items to be embedded in concrete and provide openings in the concrete necessary for performance of the Work of other Sections.

E. In advance of concrete placements, determine finish characteristics required by the Work of other Sections and provide concrete surfaces accordingly.

F. Concrete which is to receive application of other Work shall be water-cured only, and maintained free from other formwork and curing materials, unless otherwise accepted by the Local Agency / Building Official Representative.

1.10 Field Samples:

A. Provide under provisions of Division 1.

B. Construct and erect a field sample for architectural concrete surfaces receiving special treatment or finish as result of formwork.

C. Sample Panel: Sufficient size to indicate special treatment or finish required.

D. If requested by Local Agency / Building Official Representative, cast concrete against sample panel. Obtain acceptance of resultant surface finish prior to erecting formwork.

E. Locate where directed.

F. Approved sample panel is considered basis of quality for the finished work. Keep sample panel exposed to view for duration of concrete work.

G. Approved sample may remain as part of the Work.

PART 2 PRODUCTS:

2.1 Materials:

A. Concrete: Ready-mixed, ASTM C94.

B. Cement: ASTM C150.
   Type V required

C. Aggregate: ASTM C33.

D. Water: Potable, clean, not detrimental to concrete, containing less than 500 ppm of chlorides.

2.2 Admixtures:

   Manufacturer and Products
   a. Euclid Chemical Company, Eucon WR-75.
   b. Master Builders, Pozzolith 200N.
   c. Sika Chemical Corp., Plastocrete 160.

Manufacturers and Product
a. Euclid Chemical Company, Eucon Retarder-75.
b. Master Builders, Pozzolith 100XR.
c. Sika Chemical Corp., Plastiment.

C. High Range Water-Reducing Admixture (Superplasticizer): ASTM C494.
Manufacturers and Product
a. Euclid Chemical Company, Eucon 37.
b. American Admixtures, Melment L10A.
c. W.R. Grace, # WRDA-19, Superplasticizer.

Manufacturer and Product:
   a. W. R. Grace, DARAVAIR.
   b. Cemix Products, Ltd., Cemix A5.
   c. Master Builders, MBAE90.

E. Accelerator: ASTM C494, Type C or E; Non-corrosive, non-chloride.
   a. Manufacturer and Product
   b. Euclid Chemical Company, Accelguard 80.
   d. W.R. Grace, Doraset.

Submit test report from independent testing laboratory of results of an acceptable accelerated corrosion test method such as that using electrical potential measures, of minimum 1 year duration, demonstrating non-corrosive nature of product.

F. Bonding Admixture: Acrylic latex, non-rewetable type.
Manufacturer and Product
a. Euclid Chemical Company, Flex-Con.
b. The Burke Company, Burke Acrylic Bondcrete.
c. Thoro System Products, Acryl 60.
d. W. R. Grace, Daraweld C.

G. Mineral Admixture: Fly Ash Pozzolan; ASTM C618, Class F supplementary optional chemical and physical requirements of Tables 1A and 2A, except that the maximum sulfur trioxide shall be 4 percent and the maximum loss on ignition shall be 1.5 percent.
Manufacturer and Product
a. ISG Resources, Fly Ash
b. Bural Material Technologies

H. Conduit Encasement Coloring Agent: Red coloring agent for concrete used to encase electrical ducts, conduits, and similar items.
Manufacturer and Product:
   a. Davis Company, #100 Utility Red
   b. I. Reiss Company, Inc.

2.3 Accessories:

A. Curing Compound: Liquid membrane, ASTM C309, Type I; conforming to volatile organic compound (VOC) limits established by San Joaquin Valley Air Pollution Control District Regulations.
B. Sheet Curing Material: ASTM C171.

C. Hardeners: Clear, non-metallic dust-on type.

Manufacturer and Product
a. Sonneborn "Harcol Standard Natural"
b. Burke Floor Hardener
c. Lambert Corp. "Colorhard"

D. Bonding Agent

Manufacturer and Product
a. Euclid Chemical Company; Euco-Weld.
b. Larsen Products Corp.; Weld-Crete.
c. Dayton-Superior; Concrete Bonder J41.
d. American Concrete Systems, Inc.; PVA Bonder (Reemulsifiable).
e. Type: Polyvinyl acetate, rewetable type, with visible tinted pigment to verify coverage.

E. Bond Breaker

Nonstaining type, providing a positive bond prevention.

Manufacturer and Product:
a. SCA Construction Supply Division, Superior Concrete Accessories, Franklin Park, IL, Silcoaseal 77.
b. Burke Co., San Mateo, CA, Burke Clean Lift Bond Breaker WB.
c. Richmond Screw Anchor Co.; Maxi-Tilt "E" Emulsion Bond Breaker.

F. Structural Epoxy Bonding Adhesive: Two component, 100 percent solids compound suitable for use on dry or damp surfaces.

Manufacturer and Product
a. Euclid Chemical Company; Eucopoxy LPL, Euco 452M V.
b. Sika Chemical Corporation; Sikadur 32 Hi-Mod.
c. The Burke Company; Burkepoxy MV.
d. Dayton-Superior; Resi-Bond J58.

G. Patching Mortar: Epoxy type, 100 percent solids, suitable for use on damp or dry surfaces.

Manufacturer and Product
a. Euclid Chemical Company; Euco 456 Mortar.
b. Sika Chemical Corporation; Sikadur 43 Patch-Pak.
c. The Burke Company; Burkepoxy Mortar.


Manufacturer and Product
a. Vertical or Overhead Applications

1) Euclid Chemical Company; Verticoat.
2) Dayton-Superior; Poly-Fast.
3) Euclid Chemical Company; Euco Thin Coat.
4) Sika Chemical Corporation; Sikatop 121.
I. Evaporation Retardant

Manufacturer and Product
a. Euclid Chemical Company; Eucobar.
b. Master Builders; Confilm.
c. The Burke Company; Burke Finishing Aid Concentrate.
d. Dayton-Superior; SureFilm.

J. Clear Sealer: See Section 09780 type.

2.4 Joint Devices and Filler Materials:

A. Joint Filler Type A: ASTM D1751; Asphalt impregnated fiberboard or felt, 1/4-inch thick; tongue and groove profile.

B. Joint Filler Type B: ASTM D1752; Closed cell polyvinyl chloride foam, resiliency recovery of 90 percent if not compressed more than 50 percent of original thickness.

C. Joint Filler Type C: ASTM D1752; Premolded sponge rubber, fully compressible with recovery rate of minimum 95 percent.

D. Epoxy Joint Filler: Two component, 100 percent solids compound; minimum 50 shore D hardness.

Manufacturer and Product
b. Euclid Chemical Company; Euco 700.
c. The Burke Company; Burkepoxy Reflex Joint Filler.

E. Construction Joint Devices: Integral galvanized steel formed to tongue and groove profile, with removable top strip exposing sealant trough where indicated.

2.5 Mixes:

A. General Requirements

Design mixes shall be in accordance with CBC Chapter 19.

Instruct Testing Agency to base mix designs on use of materials tested and approved.

Concrete mixes shall be designed to meet strengths specified and be of uniform density without segregation when placed.

a. Structural concrete shall conform to mix design shown on plans and have a 28 day strength of 5,000 psi.

Water-cement ratio which shall control the amount of total water added to concrete for the following conditions:

<table>
<thead>
<tr>
<th>Aggregate Size</th>
<th>With Superplasticizer W/C Ratio</th>
<th>Without Superplasticizer W/C Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 inch</td>
<td>0.385</td>
<td>0.45</td>
</tr>
<tr>
<td>3/4 inch</td>
<td>0.375</td>
<td>0.44</td>
</tr>
</tbody>
</table>

Air Content: 4 to 6 percent.

Fly Ash:
b. Fly ash may be used only in concrete mixes with Portland cement Type II and IIA and shall not be used with high early strength Portland cement Type III.
c. Reduction of Portland cement, by weight, is acceptable with addition of an equal weight of fly ash provided the cement reduction shall not exceed 12 percent when comparing the mix design without fly ash to the mix design with fly ash.

Water Reducers
d. Use water-reducing admixtures in all concrete without superplasticizers.
e. Use water-reducing admixtures in all concrete with superplasticizers to allow proper mixing prior to adding superplasticizer.

Superplasticizers
f. Increasing or reducing superplasticizer dose or air-entraining admixture dose to accomplish variations in slump, working time, and air content for flowable mixes may only be accomplished at the ready-mix plant. Adjust the slump or air content at the jobsite by adding admixtures for a particular load when approved by the Local Agency / Building Official Representative, then the plant dose shall be adjusted to meet the specifications for the rest of the placement. This additional dosage at the jobsite shall be through an approved dispenser, supplied by the admixture manufacturer and otherwise at the Contractor's option.
g. Effect on Slump: Maintain required slump throughout time of concrete placement and consolidation. Discontinue use of superplasticizer if it fails to maintain slump in required range.
h. Meet design strengths, slumps, water-cement ratio, and other requirements as specified at slump required for placement.
i. Use water reducers in combination with superplasticizers as required for mixing.
j. Mix designs are subject to review. Final acceptance of materials will depend upon strength testing after placement.
k. Specifically Prohibited Admixtures:

b. 1. Admixtures containing hydrogen chloride, calcium chloride, or thiocyanates.
c. 2. Admixtures containing more than 0.05 percent chloride ions.
l. Unspecified admixtures will not be permitted, unless accepted by the Local Agency / Building Official Representative, and under condition that the Testing Agency modifies mix design as necessary, and each such modification is accepted by the Owner's Representative
m. Concrete may be designed for either pump or conventional placement. If pumping will be used, the mix shall be specifically designed for pumping and shall be so designated.

B. Dry Pack: Mix, in proportions by volume, one part cement to two-and-one-half parts fine aggregate, screening out materials retained on a No. 4 sieve. Mix with water to a consistency such that, when a ball of mixture is compressed in the hand, it will maintain its shape, showing finger marks, but not showing any surface water.

C. Patching Mortar: Mix in proportions, by volume, of one part cement to two parts fine aggregate.
2.6 Mixing:

A. Batch Plant Conditions

Equipment and plant shall be capable of weighing, proper segregation and efficient handling, and shall be subject to approval. Equipment and plant processes not approved shall not be used in the Work.

Use approved automatic metering capable of determining moisture content of sand.

B. General Requirements

Concrete mixing shall comply with CBC Chapter 19

Mix cement, fine and coarse aggregates, admixtures, and water to exact proportions of mix designs.

Measure fine and coarse aggregates separately according to approved method which provides accurate control and easy checking.

Adjust grading to improve workability; do not add water, unless otherwise recommended by the Local Agency / Building Official Representative.

Maintain proportions, values, and factors of approved mixes throughout Work.

C. Admixtures: Use automatic metering dispenser to introduce admixture into mix.

D. Mix Concrete Encasement Coloring Agent into concrete at the rate of 10 pounds of agent per cubic yard of concrete.

PART 3 EXECUTION:

3.1 Examination:

A. Verify that conditions are satisfactory for the installation of cast-in-place concrete.

B. Verify requirements for concrete cover over reinforcement.

C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

D. If unsatisfactory conditions exist, do not commence the installation until such conditions have been corrected. Beginning installation means acceptance of existing conditions.

3.2 Preparation:

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

B. In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

C. Remove loose dirt and foreign matter from excavations and forms; remove standing water and saturated soil from excavations and from cavities. Placing concrete in standing water shall not be permitted. Hardened concrete and foreign materials shall be removed from the inner surfaces of conveying equipment.
D. Thoroughly clean reinforcement and other embedded items free from loose rust and other objectionable matter.

E. Thoroughly wet wood forms, except coated plywood, and adjacent concrete at least one hour in advance of placing concrete; securely close cleanout end inspection ports; repeat wetting as necessary to keep forms damp.

F. Moisten subgrade or sand associated with under-slab vapor barrier system one day prior to placing concrete; maintain moisture until concrete placement.

G. Maintain equipment clean and of sufficient quantity and capacity to efficiently execute the Work.

H. Verify subgrade and forms have been checked for line and grade, and work areas have been observed and accepted by Owner’s Representative.

I. Before depositing new concrete on or against hardened concrete, retighten forms and prepare surface of hardened concrete as follows:
   Concrete which has been placed longer than 6-1/2 hours: Sandblast to roughen surfaces. Thoroughly clean of foreign matter and laitance, and moisten with water.
   Concrete which has been placed longer than 3-1/2 hours but less than 6-1/2 hours: Remove all laitance from concrete by wire brushing.

3.3 Placement:

A. Do not place concrete until reinforcing has been inspected and approved by Local Agency / Building Official Representative.

B. Notify the Local Agency / Building Official Representative 48 hours before each concrete placement.

C. Transporting

Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which prevent the separation or loss of the ingredients, in accordance with ASTM C94.

Concrete shall not be dropped freely where reinforcing bars will cause segregation, nor shall it be dropped more than four feet.

Spouts, elephant trunks, or other approved means shall be used to prevent segregation.

Concrete may be pumped from the transit mixer to places of deposit, provided that information on mix-design adjustments, equipment data, procedures, and the entire operation are submitted for the Local Agency / Building Official Representative’s prior review.

a. Pumps shall be suitable for the mix, aggregate size, and slump required.

b. Pump operators shall be experienced in the operation of the equipment to be used.

Use of aluminum equipment to transport concrete is not permitted.

D. Depositing
Place concrete in accordance with CBC Chapter 19.
Maintain during placement or until the completion of the section, a plastic surface approximately horizontal.
Prevent displacement of reinforcement, anchor bolts, welding plates, and other items required to be embedded in concrete.
Before concrete sets, completely remove concrete spilled on forms or reinforcing steel in portions of structure not to be immediately concreted.
Place concrete continuously between predetermined expansion, control, and construction joints. An interruption in placing of more than 60 minutes will be cause for shutting down concrete placement operations and the wasting of remaining mixed concrete, concrete in hoppers, and concrete in mixers. In case such interruption occurs, provide construction joints where and as directed, and cut concrete back to such line, cleaning forms and reinforcing as specified herein.
Keep a record of the time and data of placing the concrete in each portion of the structure. Keep reports until the completion of the structure, and keep reports open to the review of the Local Agency / Building Official Representative.

E. Consolidation
Thoroughly consolidate concrete by puddling with suitable tools during placement and thoroughly working around reinforcement, embedded fixtures, and into the corners of forms.
In addition to manual spading and tamping, internally vibrate concrete with high-speed mechanical vibrators of sufficient amplitude for adequate consolidation.
Vertically insert and remove hand-held vibrators at points 18 inches to 30 inches apart.
Do not use vibrators to transport concrete in forms.
Vibrate concrete minimum amount required for consolidation.
Do not vibrate concrete placed for slab on grade except at slab edges adjacent to edge forms and at items embedded in the slab.

F. Construction Joints
Verify location and conformance with typical details; provide only where designated or accepted by the Local Agency / Building Official Representative.
Horizontal construction joint shall conform to CBC Chapter 19.
Surface of construction joints shall be cleaned and roughened by removing the entire surface and exposing clean aggregate solidly embedded in mortar matrix in accordance with the following procedure:
Contact surface shall be thoroughly cleaned by sandblasting or chipping the entire surface not earlier than five days after the initial placement or by an accepted method that will assure equal bond such as a thorough hose washing of surface not less than two or more than four hours after concrete is placed, wash water and chalk-like material being entirely cleaned from the surface. Vertical construction joints in suspended slabs shall be sandblasted.
Prevent formation of shoulders and ledges.
Place pocket formers and diamond dowels by PDA Construction Technologies or approved equal across construction joints.

Control joints shall be located between construction joints. See plans for required spacing.

  a. Cut joints after concrete finishing, using Soff-Cut Systems or approved equivalent. Take necessary measures to prevent cracking.

3.4 Finishing - General:

A. Remove fins, projections, and loose material.

B. Patch honeycomb, aggregate pockets, voids, and holes as follows:

  Chip out until sound concrete is exposed to minimum depth of one inch.

  Prepare patching mortar with approximately two parts normal Portland cement, one-part white cement, and nine parts fine aggregate; vary proportions of cement as necessary to match color of adjacent concrete.

  Saturate surfaces with water and fill cavities with patching mortar.

  Fill holes left by form ties with patching mortar.

  Cure patches as specified for concrete.

3.5 Unformed Surface Finishes:

A. Floating

  Provide as first stage for flatwork finishes, unless otherwise specified.

  Thoroughly consolidate areas, strike off to screeds tamp to recess large aggregate below surface level.

  Fill voids, reconsolidate, and re-level surfaces as necessary.

  Do not proceed with subsequent finishes until surface water has absorbed or dried off and surface sheen has become dull.

B. Wood Float Finish

  Also provide as second stage for other finishes, unless otherwise specified.

  Using approved floating machines or hardwood trowels, float surfaces to required planes and shapes, working just sufficiently to bring surfaces to uniform condition.

  Work no more than necessary to achieve uniform texture free from irregularities and screed marks; except where receiving fills or mortar beds, leave surfaces in roughened, granular condition for good mechanical bond.

  Cut and fill surfaces as necessary to true up.

  When followed by other finishes, floating shall leave small amount of mortar on surfaces without excess of water.

  Do not proceed with subsequent finishes until surface water has absorbed or dried off and concrete has set sufficiently to prevent fines or water from being worked to the surface.

  Finish texture shall be fine-grained and granular to provide good slip-resistance, and shall be reasonably free from directional trowel marks.
Provide for exterior and interior surfaces of buildings, unless otherwise indicated.

### 3.6 Concrete Hardener and Sealers:

A. Apply in accordance with the manufacturer’s printed instructions based upon, except as specified. Apply hardener at the rate consistent with the manufacturer’s definition of light traffic areas in all areas scheduled to receive hardener.

### 3.7 Protection:

A. Maintain concrete temperature above 50º F during curing.

B. Protect concrete from sun and rain.

C. Do not subject concrete to any loads until it is completely cured and has attained its minimum 28-day strength.

D. Protect concrete during and after curing from damage from subsequent construction operations.

E. Cover traffic areas with plywood sheets; maintain paper and plywood in place and in good repair for as long as necessary to protect against damage from construction operations.

F. Keep finished areas free from traffic for a minimum of four days or as necessary until surfaces have set sufficiently to prevent damage.

### 3.8 Curing:

A. Curing shall immediately follow finishing and shall be accomplished for each portion of the Work.

B. Cure wall surfaces for a minimum of seven days by form-curing with forms wetted down thoroughly at least four times daily until forms are removed. If less than seven days, follow immediately with membrane curing if outside of building, and with fog spray to maintain moist condition inside of building. Protect concrete from damage during the curing period.

C. Flatwork Surfaces
   - Water cure all concrete work.
   - Membrane cure exterior pavement and slab surfaces.
   - Where hardener is applied, cure in accordance with hardener manufacturer’s printed instructions.
   - Do not use liquid membrane curing compounds on surfaces to receive other finishes.

### 3.9 Defective Concrete:

A. Repair or replacement of defective concrete will be determined by the Local Agency / Building Official Representative

B. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Local Agency / Building Official Representative for each individual area.
C. Defective concrete shall be repaired or replaced as recommended by the Local Agency / Building Official Representative at no additional expense to the City. Repair materials shall include cements, admixtures, epoxy, and aggregates as required by the nature of the defects.

D. With the prior acceptance of the Local Agency / Building Official Representative, some minor defective work may be repaired by use of cement mortar; however, if the defects are serious or affect the strength of the structure or its appearance, the Local Agency / Building Official Representative may require the removal and replacement of that portion of the structure affected.

E. Immediately after removing forms, concrete surfaces shall be inspected, and pour joints, voids, rock pockets, tie holes, and similar defects shall be patched at once, but not until the surfaces have first been examined by the Local Agency / Building Official Representative. Submit information on patching mixture and method proposed for use to the Local Agency / Building Official Representative for review prior to commencing.

3.10 Patching:

A. Allow Local Agency / Building Official Representative to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Local Agency / Building Official Representative upon discovery.

C. Patch imperfections as directed.

D. Patching Tie Holes

Cut nails and tie wires for form ties flush with the face of the concrete, and leave surfaces smooth and clean.

Remove metal spreader ties on exposed concrete work, or snap off inside the wall surface.

Patch resulting cone pockets on exposed surfaces, and solidly pack with cement grout.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation: Full compensation for furnishing labor, material, tools, equipment and incidentals for doing all work involved in Cast-In-Place Concrete as shown on the Plans, as specified in these Technical Specifications and as directed by the Owner's Representative, shall be included under the Contract bid items to which this work relates and no additional compensation will be allowed therefor.

END OF SECTION 03300
PART 1 GENERAL

1.1 Summary:

A. Contractor shall be responsible for procuring the services of a qualified concrete testing agency and shall provide test results back to the Owner.

B. The City will employ its own testing agency which shall be subject to performing a portion of or all of the same tests and inspections as the contractor’s testing agency.

C. Section Includes
   1. Concrete testing and inspection required by other Sections.

D. Related Sections
   1. Section 03100 – Concrete Formwork
   2. Section 03200 - Concrete Reinforcement.
   3. Section 03300 - Cast-In-Place Concrete.

1.2 References:

A. ACI 221 - Guide for Use of Normal Weight Aggregates in Concrete.

B. ACI 318 - Building Code Requirements for Reinforced Concrete.

C. ASTM International (ASTM)

D. ASTM C31 - Method of Making and Curing Concrete Test Specimens in the Field.


F. ASTM C94 - Ready-Mixed Concrete.

G. ASTM C143 - Test Method for Slump of Portland Cement Concrete.

H. ASTM C173 - Test on Fresh Concrete for Entrained Air.


1.3 Description:

A. This Section describes required testing and inspection of concrete work to be performed by Independent Testing Laboratory employed by Contractor.

B. Cooperate with testing agency employed by the City of Arvin.

1.4 Submittals:

A. Submit under provisions of Section 01 33 00.

B. Submit the Following:
   1. Certified copies of mix designs for each concrete class specified.
2. Certification that materials meet requirements specified.
3. Samples only as specified.
4. Certification from vendor that samples originate from and are representative of each lot proposed for use.
5. Mill test reports for reinforcing.
7. Certified copies of concrete reinforcement test results for tensile and bending strength.
8. Certified copies of concrete cylinder compressive strength test results at time intervals specified.
10. Certification from testing lab verifying that aggregate and gravel are asbestos-free and conform to specified gradations and characteristics.

1.5 Conditions:

A. Contractor shall allow the Testing Laboratory and Owner's Representative free access to places, whether on or off the job site, where materials are stored, proportioned, mixed, or fabricated; to places where equipment is stored or serviced; and to job site during times of preparation, installation, erection, placement, curing and patching.

B. The Contractor shall supply labor, transportation, and on-site storage facilities required by the Testing Laboratory and Owner's Representative for taking and preparing samples for testing.

1.6 Sequencing and Scheduling:

A. Notify the Owner's Representative in sufficient time prior to fabrication, field welding, mixing, and placement to permit testing and inspecting without delaying work; minimum 24-hour notice required.

PART 2 Products

2.1 Materials and Tests:

A. Test and inspect in accordance with CBC, Chapter 19 and Chapter 17 and as modified in 3.1 - 3.5 below.

B. Include reinforcement, welding, cements, aggregates, admixtures, and batch plant inspection.

2.2 Concrete:

A. The Owner's Representative Will:
   1. Review mix designs, certificates of compliance, and samples of materials proposed for use.
   2. Test and inspect materials, as necessary, in accordance with ACI 318, for compliance with requirements specified in Section 03300.

B. The Independent Testing Laboratory shall inspect plant prior to Work to verify following:
   1. Plant is equipped with approved metering devices for determining moisture content of fine aggregate.
   2. Other plant quality controls are adequate.
PART 3 Execution

3.1 Testing and Inspection of Concrete Reinforcement:

A. Independent Testing Laboratory Employed by Contractor Shall Test Reinforcing Bars as Follows:
   1. Take samples from bundles as delivered to fabricator from mill; two specimens from each 2-1/2 tons, or fraction thereof, of each size and grade.
   2. Test for tensile and bending strength in accordance with CBC Chapter 19.
   3. When bundles are identified by heat number, and accompanied by mill certificates, no testing of bars is required.

B. Independent Testing Laboratory Employed by Contractor Shall Inspect Welding as Follows:
   1. Inspect welding, including prior fit-up, welding equipment, and weld certification in accordance with AWS D1.4.

3.2 Testing and Inspection of Concrete Aggregate:

A. Independent Testing Laboratory employed by Contractor shall test and inspect aggregate as follows:
   1. Per Table 5.1 of ACI 221R.

3.3 Testing and Inspection of Concrete:

A. The Independent Testing Laboratory Employed by Contractor Shall:
   1. Perform testing in accordance with ACI 318 and CBC Chapter 17 and 19.
   2. Test slump of concrete according to ASTM C143.
   3. Test concrete for required compressive strength in accordance with CBC Chapter 19 and as follows:
      a. Make and cure specimen cylinders according to ASTM C31 for each class poured at site as directed by Owner's Representative.
      b. Retain one cylinder for 7 day test, one for 14 day test and three for 28 day test. Hold one cylinder for subsequent testing, if necessary.
      c. Number each cylinder 1A, 1B, 1C, 1D, 1E, 1F, 2A, 2B, 2C, etc.; date each set; and keep an accurate record of placement on what each set represents.
      d. Transport specimen cylinders from job to laboratory.
      e. Test specimen cylinders at age 7 days, 14 days and age 28 days for specified strength according to ASTM C39.
   4. Take core specimens of hardened structure and test specimen according to ASTM C42 when laboratory tests of specimen cylinders show compressive strengths below specified minimum.
   5. Test for air entrainment as specified in design mix as per ASTM C173.
   6. Frequency of testing shall conform to CBC Chapter 19.

B. The Contractor shall:
   1. Submit ticket for each batch of concrete delivered to jobsite. Ticket shall bear following information:
      a. Design Mix Number.
      b. Time of batching.
      c. Weight of cement, aggregates, water, and admixtures with maximum aggregate size.
      d. Total volume of concrete.
C. Concrete Placed Without Inspection by Owner's Representative
   1. Owner's Representative will determine the most suitable method of ascertaining quality of concrete.
   2. Contractor shall bear all expenses for X-ray or other inspection of in-place concrete.
   3. Contractor shall bear all expenses for removing concrete determined to be unsuitable.

3.4 Retesting:

   A. When tests or inspections reveal failure of materials to meet Contract requirements, Independent Laboratory shall provide additional tests in accordance with specified requirements as necessary until acceptance.

   B. The cost of additional testing by the City of Arvin testing agency made necessary because of the failure of materials to meet Contract requirements will be deducted from the Contract Price in the form of a deductive change order at the end of the project.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation: Full compensation for furnishing labor, material, tools, equipment and incidentals for doing all work involved in Concrete Testing and Inspection as shown on the Plans, as specified in these Technical Specifications and as directed by the Owner's Representative, shall be included under the Contract bid items to which this work relates and no additional compensation will be allowed therefor.

END OF SECTION 03305
PART 1 GENERAL

1.1 Section Includes

A. Excavation and backfill.
B. Cast-in-place concrete structures.
C. Precast concrete structures.
D. Metal components.

1.2 Related Sections

A. Concrete formwork, concrete reinforcement, cast-in-place concrete, Portland cement concrete, concrete repair and finishing, and precast concrete are specified in the various Sections under Division 3 – Concrete.

1.3 References

A. City of Arvin Standards
B. City of Arvin Quality Assurance Plan (QAP)
C. Project Specifications and Drawings.
D. American Society for Testing and Materials (ASTM)
   ASTM A36/A36M Specification for Structural Steel
   ASTM A48 Specification for Gray Iron Castings
   ASTM A108 Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
   ASTM A123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   ASTM A153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
   ASTM A536 Specifications for Ductile Iron Castings
   ASTM B3 Specification for Soft or Annealed Copper Wire
   ASTM B26/B26M Specification for Aluminum-Alloy Sand Castings
   ASTM C33 Specification for Concrete Aggregates
   ASTM C150 Specification for Portland Cement
   ASTM C260 Specification for Air-Entering Admixtures for Concrete
   ASTM C270 Specification for Mortar for Unit Masonry
   ASTM C478 Specification for Precast Reinforced Concrete Manhole Sections
   ASTM C618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C789 Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
ASTM C850 Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than 2 feet of Cover Subjected to Highway Loadings

ASTM C858 Specification for Underground Precast Concrete Utility Structures
ASTM C891 Practice for Installation of Underground Precast Concrete Utility Structures

E. California Code of Regulations (CCR)
Title 24, Part 2, California Building Code, Chapter 21, Masonry, and State Chapter 1A, Masonry.

F. State of California, Department of Transportation (Caltrans)

1.4 Submittals

A. Submit under provisions of Sections 01 33 00.

B. Product Data: Submit manufacturers’ product data for standard manufactured precast concrete utility boxes and structures and for metal gratings and covers and other, related miscellaneous metal items.

C. Certification: Submit certification or other acceptable evidence that covers and grates to be provided for roadways meet proof-testing requirements for H20 and HS20 loadings in accordance with Caltrans Bridge Design Specifications Manual, Section 3.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Caltrans Standard Specifications, and Arvin QAP. In the event of discrepancies, these specifications shall govern.

PART 2 PRODUCTS

2.1 Cast-In-Place Concrete Structures

A. Materials
Portland Cement: ASTM C150, Type II and Type V.
Cementitious Admixture: Provide fly ash or pozzolan conforming with ASTM 618, Class F or N, not to exceed 15 percent by weight of the cement content.
Aggregates: ASTM C33, fine aggregate and Size Nos. 56 or 57 (1-inch maximum size) coarse aggregate.

B. Mix Design
Concrete Compressive Strength: 4,000 psi minimum.
Maximum water-cement plus pozzolan ratio: 0.45.
Maximum slump: 4 inches.

2.2 Precast Concrete Structures

A. General: The Contractor may provide precast concrete structures that conform to the general configuration, capacities, and inverts indicated.

B. Fabrication Standards: Comply with requirements of Section 03462 - Precast Concrete, and ASTM C478, ASTM C789, ASTM C850, and ASTM C858, as applicable and applicable manufacturers’ standards.

C. Materials: Comply with requirements as specified otherwise herein. Provide fine and coarse aggregates conforming to ASTM C33, in size commensurate with structure and reinforcement clearances.

D. Portland Cement Concrete: 4000 psi minimum compressive strength. Concrete may be polymer or latex modified to achieve higher strengths and denser concrete. Concrete shall not deteriorate from chemical attack of sanitary waste.

E. Quality Control: In accordance with Section 01452 - Testing Services, the Contractor shall perform such inspections and tests as required to verify compliance with these Specifications.

2.3 Metal Covers, Grates, and Inlets

A. Ferrous Castings

Metal used in manufacture of castings shall conform to ASTM A48, Class 35B for gray Iron, or ASTM A536, Grade 65-45-12 for Ductile Iron.

Castings shall be of uniform quality, free from blowholes, shrinkage, distortion or their defects. Castings shall be smooth and cleaned by shotblasting.

Minimum tensile strength shall be 35,000 psi.

Castings shall be manufactured true to pattern; component parts shall fit together in a satisfactory manner. Round frames and covers shall have continuously machined bearing surfaces to prevent rocking and rattling.

Where castings will be subjected to loads of H20 or greater, as indicated, provide ductile iron castings.

B. Grates

Cast Ferrous Grates: Grates for area drains and catch basins shall be heavy-duty, bicycle safe inlet grates and frames of size and configuration indicated. Grates in roadways and parking areas shall withstand H20 loadings when proof-tested in accordance with Caltrans Bridge Design Specifications Manual, Section 3.

Bar-Type Steel Grates: Refer to Section 05500 - Metal Fabrications, for requirements. Bar-type steel gratings will be permitted only in areas where vehicular traffic will not be encountered.

C. Curb and Gutter Inlets

Provide cast, manufactured curb inlet frame, grate, and curb box of size and configuration indicated. Curb and gutter inlets shall conform to the contour and profile of the concrete curb and gutter. Grates shall be heavy-duty and bicycle-safe and shall withstand H20.
2.4 Miscellaneous Metal

A. Requirements: Provide channel inserts, pulling eyes, ladders, and electrical grounding rods for electrical manholes and pull boxes as indicated.

B. Steel Materials: Standard structural sections, shapes, plates, bars, and rods, as indicated, conforming with ASTM A36/A36M. Bars conforming with ASTM 108 will be acceptable.

C. Anchors and Bolts: Bolts and studs, nuts, and washers shall be hot-dip galvanized in accordance with ASTM A153.

D. Galvanizing: All ferrous metal items shall be galvanized after fabrication by the hot-dip process in accordance with ASTM A123. Weight of the zinc coating shall conform with the requirements specified under "Weight of Coating" in ASTM A123.

2.5 Mortar

A. Cement mortar for the sealing of openings for pipe penetrations, for cementing of joints of component parts of precast structures, for providing of flow characteristics for the bottoms of drainage structures, and other features as indicated shall conform with the California Building Code, Chapter 21, Type S (without lime), with a minimum compressive strength at 28 days of 1,800 psi.

B. Mortar shall comply with applicable requirements of ASTM C270, including measurement, mixing, proportioning, and water retention. Ten percent by volume of the cement content of the mortar shall be fly ash or pozzolanic material conforming with ASTM C618.

C. Use mortar within 90 minutes after mixing. Discard mortar that has been mixed longer or that has begun to set. Re-tempering of mortar will not be permitted.

PART 3 EXECUTION

3.1 Installation

A. Requirements: Construct catch basins, curb and gutter inlets, culverts, utility boxes and vaults, and related utility structures in connection with the installation of pipe and utility trenches, as indicated.

B. Excavation and Backfill: Provide excavation, prepared subgrade and aggregate base, and backfill as specified in Section 02202 - Earthwork, Section 02302 - Trenching and Backfilling, and Section 02530 -Aggregate Base Course, as indicated.

C. Precast Concrete Structures: Install as indicated. Comply with applicable requirements of ASTM C891. Provide such appurtenances and installation accessories, including cement mortar and sealants, as required for a complete installation.

D. Metal Components: Install grates and frames, curb and gutter inlets, metal steps, as indicated and in accordance with the respective manufacturer's instructions. Covers and grates in roadways and concrete walks shall be installed flush with adjacent, abutting pavement.
3.2 Field Quality Control
   A. The Contractor shall perform slump tests and strength tests of cast-in-place structures.

3.3 TESTING AND INSPECTION
   A. The City shall test newly placed concrete as required by the QAP. Any materials determined to be in non-compliance with project requirements must be removed and replaced at no additional cost to the Owner. Additional tests shall be at the cost of the contractor and shall be deducted from the contract price via a deductive change order.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation
   Full compensation for furnishing labor, material tools, equipment and incidentals for doing all work involved in utility structures, as specified in these Technical Specifications and as directed by the Project Representative, shall be included under the Contract Bid Item of this work relates and no additional compensation will be allowed therefor.

END OF
SECTION 03310
SECTION 4100
BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 Summary
A. Section Includes
   1. Basic Electrical Requirements specifically applicable to all Sections in Division 6.

1.2 References
B. Energy Star - United States Environmental Protection Agency Energy Star Program.
C. NEMA ICS-6 Enclosures for Industrial Controls and Systems.

1.3 Intent of Drawings
A. Electrical plan drawings show only general locations of equipment, devices, and raceway, unless specifically dimensioned.

1.4 Submittals
A. Submit under provisions of Section 01220.
B. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.
C. Submit material control record procedures for approval. Submit records during the project upon request by the Owner’s Representative. Submit at the end of the project for record.

1.5 Regulatory Requirements
A. Conform to CEC.
B. Furnish products listed and classified by UL or other independent laboratory acceptable to Owner’s Representative as suitable for purpose specified and shown when a listing is available for the type of product.
C. Where available, provide products compliant with the Energy Star program.

1.6 Project/Site Conditions
A. Install Work in locations shown on Drawings, unless prevented by Project conditions. In that event, notify Owner’s Representative immediately.
B. Prepare and submit drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Owner’s Representative before proceeding.
1.7 Sequencing and Scheduling
   A. Construct Work in sequence under provisions of Section 01120.

1.8 Description of Systems
   A. Furnish and install all materials to provide functioning systems in compliance with performance requirements specified, and any modifications required by reviewed shop drawings and field coordinated drawings.

1.9 Weatherproof Equipment
   A. Where weatherproof (WP) equipment is indicated, use NEMA ICS-6 4 cast metal or stainless steel enclosures unless otherwise specified or indicated.

1.10 Material Control and Handling:
   A. Maintain material control records for all products for traceability to manufacturer and order number. Have records available for inspection by Owner’s Representative.
   B. Store material and equipment in an environment similar to the final installation environment.
   C. Store and handle material and equipment in accordance with manufacturers recommendations.
   D. Store and handle material and equipment in accordance with Sections 01400 and 01410.
   E. Store and handle material and equipment in an environment similar to the final installation environment, in accordance with manufacturers recommendation, and in accordance with Division 1.

PART 2 PRODUCTS
   Not Used

PART 3 EXECUTION
3.1 Installation, Common Requirements
   A. Coordinate work with Owner’s Representative and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operations of the institution during construction.
   B. Install tamper proof metal fasteners at inmate accessible areas in accordance with manufacturers' instructions, using tools designed for fastener installation and removal. Set non-removable tamper proof metal fasteners with screw thread adhesive sealant in accordance with manufacturers' instructions.
   C. Check and coordinate the approximate locations of conduit stub-outs, light fixtures, outlets, equipment, and other system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify the Owner’s Representative in writing. The Owner’s Representative's decision shall govern. Make modifications and changes required to correct conflicts.
3.2 Protection During Construction

A. Prior to installation, items subject to corrosion under damp conditions, and items containing electrical insulation, such as transformers, conductors, motors, and controls shall be stored indoors, in a clean, dry, and heated location.

B. Energize all space heaters furnished with equipment.

C. If items cannot be stored indoors, and space heaters not furnished, provide temporary heating to prevent condensation. Energize space heaters if furnished with equipment.

D. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. When equipment intended for indoor installation is installed at the Contractor's convenience in areas where it is subject to dampness, moisture, dirt, or other adverse atmosphere until completion of construction, ensure that adequate protection from these atmospheres is provided that is acceptable to the Owner’s Representative. Cap conduit runs during construction with manufactured seals. Keep openings in boxes or equipment closed during construction. Energize all space heaters furnished with equipment.

3.3 Final Performance Test

A. At completion of installation, test for operation, panel load balance, short circuits, and ground.

B. Each building service and separately derived system to have neutral bonding jumper opened and neutral and ground buses to be tested for infinite resistance. Demonstrate test to Owner’s Representative. Where infinite resistance is not received, correct deficiencies and retest in presence of Owner’s Representative.

3.4 Final Connection

A. Make final connection to the power distribution system at the building service point.

3.5 Adjust and Clean

A. Adjust, clean, inspect, and put in good working order all equipment.

3.6 Putting Systems in Operation – Start Up

A. Operate all systems as shown and specified, for a period of 5 consecutive days, during a period agreed to by Owner’s Representative, prior to inspection.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation

Full compensation for furnishing labor, material, tools, equipment and incidentals for doing all work involved in Electrical as shown on the Plans, as specified in these Technical Specifications and as directed by the Owner’s Representative, shall be included under the Contract items to which this work relates and no additional compensation will be allowed therefor.

END OF SECTION
4100
SECTION 4110
CONDUIT

PART 1 Summary

A. Section Includes
   1. Rigid metal conduit.
   2. PVC coated rigid metal conduit
   3. Flexible metal conduit.
   4. Liquid-tight flexible metal conduit.
   5. Electrical metallic tubing.
   6. Rigid nonmetallic conduit.
   7. Fittings.

B. Related Sections
   1. Section 02250 - Trenching and Backfill.
   2. Section 06100 - Basic Electrical Requirements.
   3. Section 06130 – Outlet Boxes.
   4. Section 06150 - Grounding.
   5. Section 06170 – Supporting Devices.
   6. Section 06180 - Electrical Identification.

1.2 References

A. American National Standards Institute (ANSI)
   1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
   2. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
   3. ANSI C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing.
   4. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.


C. Federal Specifications (FS)

D. NECA - (National Electrical Contractor’s Association) "Standard of Installation."
E. National Electrical Manufacturers Association (NEMA)
1. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
2. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
3. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing

F. Underwriters Laboratories Inc. (UL)
1. UL 1 - Underwriters Laboratories, Flexible Metal Electrical Conduit.
2. UL 6 - Underwriters Laboratories, Standards for Safety, Rigid Metal Conduit.
3. UL 360 - Underwriters Laboratories Safety Standards for Liquidtight Flexible Steel Conduit.
4. UL 514B - Underwriters Laboratories Safety Standards for fittings for Conduit and Outlet Boxes.
5. UL 651 - Underwriters Laboratories, schedule 40 and 80 PVC conduit.
6. UL 797 - Underwriters Laboratories, Standards for Safety, Electrical Metallic Tubing.

1.3 Design Requirements
A. Conduit Size: As indicated. When not indicated or when equipment has been substituted, size per CEC except no smaller than 3/4 inch.

1.4 Submittals:
A. Submit under provisions of Section 01220.
B. Certify compliance with CEC Article 110 - Requirements for Electrical Installation.

1.5 As-Built Documents
A. Submit under provisions of Section 01220.
B. Accurately record actual routing of all conduit.

1.6 Project Conditions
A. Verify that field measurements are as shown on Drawings.
B. Verify routing and termination locations of conduit prior to rough-in.
C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 PRODUCTS

2.1 Rigid Metal Conduit
A. Rigid Steel Conduit: ANSI C80.1, UL 6.
1. Stamp each length with manufacturers name or trademark and U/L label.

B. Conduits in corrosive areas shall be stainless steel, O-CAL, or approved equal.

2.2 PVC Coated Rigid Metal Conduit
A. Rigid steel conduit with external PVC coating, 40 mil thick: Requirements for rigid steel conduit and NEMA RN 1.
B. Fittings and Conduit Bodies: Steel fittings with external PVC coating to match conduit.
C. Tape for Joints: As recommended by conduit manufacturer.
D. PVC Coating on conduit and fittings shall have no sags, blisters or other surface defects and shall be free of holes.

2.3 Flexible Metal Conduit

2.4 Liquid Tight Flexible Metal Conduit
A. Interlocked steel construction with PVC jacket: UL 1 and UL 360.

2.5 Electrical Metallic Tubing (EMT)
A. Galvanized Steel Tubing: ANSI C80.3, UL 797.
B. Maximum size shall be 2 inches.

2.6 Nonmetallic Conduit
A. Schedule 40 PVC: NEMA TC 2 and UL 651.
   1. Mark each length clearly and durably with size type of material and U/L label.
B. Solvent and Cement: In accordance with manufacturers recommendations.

2.7 Fittings
A. Acceptable Manufacturer
   1. Thomas and Betts, (T&B).
      a. For reference, Thomas & Betts series numbers are listed below.
   2. Appleton.
   4. O.Z. Gedney.
B. Standards
   1. Metallic: ANSI/NEMA FB1, ANSI C80.4 and UL 514B ferrous.
C. Locknuts:
   1. Hardened Steel or malleable iron construction, electro zinc plated, capable of insuring positive bond to enclosure.
      a. Non-bonding: T & B Series 140
      b. Bonding: T & B Series 106

D. Bushings:
   1. Insulated: T & B Series 222.

E. Couplings:
   1. Non-metallic Conduit Coupling: By non-metallic conduit manufacturer for the purpose.
   2. Threaded Rigid Metal Conduit Couplings: By conduit manufacturer for the purpose.
   3. Threadless Coupling: "Erickson" Type; T & B Series 674.
   4. EMT Coupling, Raintight: T & B Series 5120.
   5. Expansion Type: Permit 3/4 inch movement any direction.
      a. Exposed: Weatherproof with external bonding jumper.
      b. Embedded: Watertight with internal bonding jumper.

F. Connectors:
   1. Non-Metallic Conduit Connector: By conduit manufacturer for the purpose.
   2. Threaded Hubs: Electro zinc coated with nylon insulated throat and oil/moisture resistant recessed sealing ring, raintight.
   4. EMT to Rigid Metal Conduit Connector: Raintight - T & B Series 530.
   5. Flexible metal conduit connector - Insulated throat, suitable as grounding means. T & B Series 3110.
      b. External Bonding - T & B Series 5331 GR.

G. Nipple: "Chase" Type, Insulated; T & B Series 1942.

H. Sealing Gaskets: Oil and moisture resistant rubber bonded to metallic retainer.
   1. With rigid conduit - T & B Series 5302.
3. Fittings not specifically listed but required shall be of similar style and quality.

2.8 Conduit Bodies:
   B. Ferrous with threaded hubs and gasketed cover.

2.9 Sealant
   A. Internal to fittings.
      1. Approved by manufacturer for application.
      2. Manufacturer:
         b. O.Z. Gedney.

2.10 Warning Tape:
   A. Tape: Heavy-gage, yellow plastic; minimum 6-inch width for use in trenches containing electric circuits; material resistant to corrosive soil and containing a metallic tracer wire for use with cable locators; printed warning that electric circuit is located below the tape.
      1. Manufacturers and Types:
         a. 3M.
         b. Calpico.
         c. Plymouth, Vinyl Tape.
         d. Griffolyn Co, Terra Tape.
         e. ITT Blackburn, Type YT or RT.

2.11 Cable/Conduit Locator:
   A. Locator: Hand-held, self contained, cable/conduit locator capable of inducing a signal on a cable and detecting a 60-Hz power signal.

PART 3 EXECUTION

3.1 Installation – General
   A. Installation Standards:
      1. Ground conduit under provision of Section 06150.
      2. Identify conduit under provisions of Section 06180.
      3. Install nonmetallic conduit in accordance with manufacturer's instructions.
      4. Provide heavy nylon cord pull string in each empty conduit except sleeves and nipples. Pull line to have a minimum of 200 pound pull strength. Tag each end of string with destination. Leave a minimum of 24 inches of slack at each end.
      5. Within finished areas of building. Install all conduits concealed.
6. Exposed conduit may be used in these non-inmate accessible areas: Switchgear Rooms, Mechanical Equipment Rooms, Electric Closets, and Equipment Rooms only.

7. Locate boxes in accordance with Section 06130 before installing conduit.

8. Do not use setscrew type couplings, bushings, elbows, nipples, or other fittings for Intermediate Metal Conduit unless specifically approved by the Owner’s Representative.

9. All raceways shall be identified with tags at each end, the origin and the destination.

B. Supports:
   1. Arrange supports to prevent misalignment during wiring installation.
   2. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
   3. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
   4. Fasten conduit supports to building structure and surfaces under provisions of Section 06170.
   5. Do not attach conduit to ceiling support wires.
   6. Conduit Installation:
      a. Support all conduit systems from building structure or walls with approved hangers.
         1) Do not support from piping, ducts or support system for piping or ducts.
         2) Do not install to prevent ready removal of piping, ducts or ceiling tiles.
         3) Do not support from ceiling or ceiling support systems.

C. Routing:
   1. Arrange conduit to maintain headroom and present neat appearance.
   2. Route conduit in and under slab from point-to-point.
   3. Route other conduit parallel and perpendicular to walls.
   4. Maintain adequate clearance between conduit and piping.
   5. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C).
   6. In outdoor, underground, or wet locations, use watertight couplings and connections in raceways.
   7. Paint threads of galvanized conduits that are installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound before assembling.
   8. Do not notch or penetrate structural members for passage of raceways except with prior approval of the Owner’s Representative.
   9. Do not run raceways in equipment foundation pads.
   10. Install concealed, embedded, and buried raceways so that they emerge at right angles to the surface and have none of the curved portion of the bend exposed.

D. Fitting:
1. Cut conduit square using saw or pipecutter; de-burr cut ends.
2. Bring conduit to shoulder of fittings; fasten securely.
3. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
4. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
5. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate bends in metal conduit larger than 2 inch size.
6. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
7. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control and expansion joints.
8. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
9. Make joints in threaded conduit watertight with white nonleaded compound applied to male threads only.
   a. Cut square, ream smooth, and properly thread filed joints to receive couplings.
   b. Do not use running threads.
   c. Fit all conduit ends at switch and outlet boxes with approved lock nuts and bushing forming approved tight bond with box when screwed tightly in place.
10. Remove moisture and debris from conduit before wire is drawn into place. Tightly plug ends of conduit with plastic inserts until wire is pulled.
11. Neatly seal openings around conduits, etc., where they pass through fire rated construction or exterior walls or roof.
12. Except for grease ducts, install conduit to roof exhaust fans through fan housing with no conduit exposed.
13. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation.
14. Provide escutcheon plates at exposed wall, ceiling and floor conduit penetrations.

E. Bends:

1. Make changes in direction of runs with symmetrical bends or cast metal fittings. Make bends and offsets of the longest practical radius. Avoid field-made bends and offsets where possible, but where necessary, make with an acceptable hickey or conduit bending machine. Do not heat metal raceways to facilitate bending.
2. Make bends in parallel or banked runs of raceways from the same center or centerline so that bends are parallel and of neat appearance. Factory elbows may be used in parallel or banked raceways if there is a change in the plane of the run and the raceways are of the same size. Otherwise, make field bends in parallel runs.
3. For PVC conduits, use factory made elbows for all bends 30 degrees or larger. Use acceptable heating methods for forming smaller bends.
4. For duct bank runs for site electrical distribution, use only large radius sweeps or large radius elbows.
a. For 2” conduits and smaller, radius shall be a minimum of 12 times the nominal diameter of the conduit.

b. For conduits larger than 2”, radius shall be a minimum of 9 times the nominal diameter of the conduit.

5. For duct bank runs for site signal/communication ducts, use only large radius sweeps or large radius elbows.
   a. Radius shall be a minimum of 12 times the nominal diameter of the conduit.

6. Make no bends in flexible conduit that exceed allowable bending radius of the cable to be installed or that significantly restricts the conduits flexibility.

F. Bushing and Insulating Sleeves:

1. Where metallic conduit enters metal equipment enclosures through conduit openings, install a bonding bushing on the end of each conduit. Install a bonding jumper from the bushing to any equipment ground bus or ground pad.

2. If neither exists, connect the jumper to a lag-bolt connection to the metallic enclosure.

3. Use manufacturer's standard insulating sleeves in all metallic conduits terminating at an enclosure.

G. Penetrations:

1. Seal the interior of all raceways entering structures including manholes, handholes, and pullboxes at the first box or outlet with oakum or suitable plastic expandable compound to prevent the entrance into the structure of gases, liquids, or rodents.

2. Dry pack with nonshrink grout around raceways that penetrate concrete walls, manholes, handholes, pullboxes, or floors, or use one of the methods specified for underground penetrations. The seal shall prevent water seepage around the raceways.

3. Where an underground raceway enters a structure through a non-waterproofed wall, install a sleeve made of Schedule 40 galvanized pipe. Fill the space between the conduit and sleeve with a suitable plastic expandable compound, or an oakum and lead joint, on each side of the wall in such a manner as to prevent entrance of moisture. A watertight entrance sealing device may be used in lieu of the sleeve.

4. Where raceways penetrate fire-rated walls, floors, or ceilings, fire stop openings around electrical penetrations to maintain the fire-resistance rating.

3.2 Installation Requirements for Underground Direct Burial Raceways

A. General:

1. Coordinate installation of underground raceways with other outside and building construction work.

2. Remove entirely and properly reinstall all raceway installations not in compliance with these requirements.

3. Do not use union type fittings underground.

4. Provide a minimum cover of 2 feet over all low voltage and communication underground raceways unless otherwise indicated. Provide a minimum cover of 36 inches over all high voltage underground raceways.

5. Do not backfill underground direct burial raceways until they have been inspected by the Owner’s Representative.
6. Warning Tapes: Bury warning tapes approximately 12 inches above all underground conduit runs or duct banks. Align parallel to and within 12 inches of the centerline of runs.

7. Trenching requirements shall be in conformance with Specification Section 02250.

B. Separation and Support:

1. Separate parallel runs of two or more raceways in a single trench with preformed, nonmetallic spacers designed for the purpose. Install spacers at intervals not greater than that specified in the CEC for support of the type raceways used, and in no case greater than 10 feet.

2. Support raceways installed in fill areas to prevent accidental bending until backfilling is complete. Tie raceways to supports, and raceways and supports to the ground, so that raceways will not be displaced when concrete encasement or earth backfill is placed.

C. Arrangement and Routing:

1. Arrange multiple conduit runs substantially in accordance with any details shown on the Drawings and as required in the California Electric Code. Locate underground conduits where indicated on the Drawings.

2. Make minor changes in location or cross-section as necessary to avoid obstructions or conflicts. Where raceway runs cannot be installed substantially as shown because of conditions not discoverable prior to digging of trenches, refer the condition to the Owner’s Representative for instructions before further work is done.

3. Where other utility piping systems are encountered or being installed along a raceway route, maintain a 12-inch minimum vertical separation between raceways and other systems at crossings. Maintain a 12-inch minimum separation between raceways and other systems in parallel runs unless otherwise indicated. Do not place raceways over valves or couplings in other piping systems. Refer conflicts with these requirements to the Owner’s Representative for instructions before further work is done.

4. Provide bell-ends flush with manhole walls on all nonmetallic raceways entering manholes.

5. In multiple conduit runs, stagger raceway coupling locations so that couplings in adjacent raceways are not in the same transverse line.

6. All conduits shall enter manholes and structures at right angles.

3.3 Product Application – Raceway – General Locations:

A. Underground

1. Conduit:
   a. PVC Coated Rigid Metal Conduit.
      1) Wrap connection point of fitting and conduit to maintain integrity of coating system.
   b. Rigid Nonmetallic conduit.

2. Encase underground conduits to 5 feet of building concrete where passing under roadways.

3. Install underground conduit 18 inches minimum below grade. Do not backfill before observation by Owner’s Representative. Field coordinate elevation of conduits provided by Site Work/Utilities Contractor.
4. Separate conduit by 3 inches.

5. Make transition from underground rigid non-metallic conduit to PVC coated rigid metal conduit at slab level, or grade if no slab.

B. Outdoors, Above Grade:
   1. Do not install in exercise yards unless specifically indicated.
   2. Liquid-tight Flexible Conduit:
      a. Where greater than 12 feet above grade in exercise yard where allowed.
      b. Other locations where protected from physical damage.
      c. Maximum 3-foot lengths.
   3. Electrical Metallic Tubing:
      a. Do not use in exercise yards.
      b. Where protected from weather and physical damage.
   4. Rigid Metallic Conduit:
      a. Use in exercise yard where allowed.
      b. Other locations not otherwise indicated.

C. In Slabs and Masonry:
   1. Rigid metal conduit.
   2. Rigid nonmetallic conduit.
   3. PVC coated rigid conduit.
   4. Conduits to be installed in precast concrete during casting and through extruded concrete planks.
   5. Install no conduit larger than 3/4 inch in floor slabs on grade.
      a. Where installed in composite floors, conduit runs shall have no crossovers.
      b. Do not install conduit under pads for fans, pumps, boilers, or other machinery.
   6. Install expansion joint fittings on conduit in slab at all building expansion joints. Allow for the high rate of thermal expansion and contraction of PVC conduit by providing PVC expansion joints as recommended by the manufacturer and as required.
   7. In concrete floor slabs, not on grade:
      a. Install conduits so that the structural strength of the slab is not impaired.
      b. Install conduit in the middle one-third of the slab except as necessary to avoid structural reinforcement material and maintain at least one inch of cover.
      c. Provide minimum spacing of 3 diameters except at cabinet and panel locations.
      d. Do not cross conduits.
      e. Place conduit larger than 1 inch parallel with or at right angles to reinforcement.
   8. Maximum Allowable Conduit Size in Masonry Walls: 3/4 inch diameter at 6 inch nominal CMU; 1-1/4 inch diameter at 8 inch nominal CMU.

D. Dry Locations - Concealed:
1. Rigid metal conduit.
2. Flexible metal conduit. Fixture connections with 1/2 inch flexible metal conduits, with a separate grounding wire, in excess of 6 feet are permitted where allowed by the California Electric Code.
3. Liquid-tight flexible metal conduit.
4. Electrical metallic tubing.
5. Connections and Fittings:
   a. Above lay-in tile ceilings, make connections to lay-in type fixtures with ½-inch x 6 feet long flexible metal conduit.
      2) Include No. 12 branch and grounding conductors.
      3) Arrange conduit and box systems for easy removal of lay-in ceiling.

E. Dry Locations - Exposed.
1. Rigid metal conduit.
2. Flexible metal conduit - 6 feet maximum length. Fixture connections with 1/2 inch flexible metal conduits, with a separate grounding wire, in excess of 6 feet are permitted where allowed by the California Electric Code.
3. Liquid-tight flexible metal conduit - 6 feet maximum length.
4. Electrical metallic tubing.
5. Inmate Accessible Areas: Rigid metal conduit only.

3.4 Product Application – Raceway – Special Locations:

A. The following requirements modify the general location requirements listed above.

B. Motor Connections:
1. Make motor and equipment connections with flexible metal conduit not exceeding 24 inch length.
   a. Use liquid-tight metal conduit in damp and wet locations.
   b. Damp locations include but are not limited to: Dietary production, dishwashing, decontamination sterilizers and pumps.

3.5 Product Applications – Connections:

A. Rigid Metal Conduit:
1. At building expansion joints, use expansion type fittings.
2. Where an expansion type fitting is not required, use a threaded rigid metal conduit coupling or "Erickson" type coupling as appropriate.
3. Make connections to NEMA 12 boxes with a threaded hub.
4. Make connections to a threadless opening with locknuts on the inside and outside of the box. The conduit end shall be fitted with an insulating bushing. In wet locations, a sealing gasket shall be provided between the outside locknut and the box.
5. Bonding type locknuts shall be used where the raceway and associated fittings are part of the equipment grounding system.
6. Insulated grounding and bonding bushings shall be used to terminate service conduits, rigid metal conduit used as the grounding electrode conductor enclosure, where assurance of electrical continuity between isolated sections of raceways is required in accordance with CEC and where a bonding jumper around unpunched knockouts is required in accordance with CEC.

7. Terminate in sealing type fittings when leaving refrigerator and freezer boxes and when leaving hazardous areas.

8. Repair any marred galvanized finish to maintain the same level of corrosion protection.

B. PVC Coated Rigid Metal Conduit:
1. Tape over all connections below grade to maintain the continuity of the corrosion protection.
2. Repair any damaged PVC covering of the conduit or fittings.
3. The requirements for rigid metal conduit also apply.

C. Flexible Metal Conduit:
1. Terminate with a flexible metal conduit connector. Use a locknut in unthreaded boxes.

D. Liquid-tight Flexible Metal Conduit:
1. Terminate with a liquid-tight flexible metal conduit connector. Use external bonding type with equipment bonding jumper in hazardous locations (where allowed). Fasten bonding jumper to conduit with cable ties every foot.
2. In wet locations, use a sealing gasket.

E. Electrical Metallic Tubing:
1. At building expansion joints, use expansion type fittings.
2. Where an expansion type fitting is not required, use an EMT coupling to connect EMT sections.
3. Make connections with EMT connectors.

F. Rigid non-metallic conduit:
1. Make connections in accordance with the manufacturers published instructions.
2. Allow connections to fully set up before making bends.

G. System-to-System Connections:
1. Make EMT to rigid metal conduit connections with an EMT to rigid metal conduit connector.
2. Make a box-to-box connection with a "chase" type nipple and locknut.

3.6 Preparation for Pulling in Conductors:

A. Do not install crushed or deformed raceways. Avoid traps in raceways where possible. Take care to prevent the lodging of plaster, concrete, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Make raceways entirely free of obstructions or replace them. Ream all raceways, remove burrs, and clean raceway interior before introducing conductors or pull wires.
B. Immediately after installation, plug or cap all raceway ends with watertight and dust-tight seals until the time for pulling in conductors. Provide a permanent removable cap over each end of each empty raceway.

3.7 Empty Raceways:

A. Certain raceways will have no conductors pulled in as part of this Contract. Identify with tags at each end the origin and destination of each such empty raceway. Provide a permanent cap over each end of each empty raceway. Provide a nylon pull wire in each empty raceway.

3.8 Testing and Inspection:

A. Do not cover up conduit work until inspected. Notify Owner’s Representative at least 3 days before inspection is desired.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation

Full compensation for furnishing labor, material, tools, equipment and incidentals for doing all work involved in Conduit work as shown on the Plans, as specified in these Technical Specifications and as directed by the Owner’s Representative, shall be included under the Contract items to which this work relates and no additional compensation will be allowed therefor.

END OF SECTION
4110
PART 1 GENERAL

1.1 Summary

A. Section includes:
   1. Conductors (600V and below).
   2. Wiring connectors.
   3. Communications data cable.

B. Related sections
   1. Section 06100 – Basic Electrical Requirement
   2. Section 06180 – Electrical Identification.

1.2 Reference


B. Underwriters Laboratories Inc. (UL)
   1. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper.
   2. UL 510 - Insulating Tape.

1.3 Submittals

A. Submit under provisions of Section 01220.

B. Certify compliance with CEC Article 110 - Requirements for Electrical Installation.

C. Submit certified megger test results.

1.4 Qualifications

A. Manufacturer: Company specializing in the manufacture of products of the type specified in this Section; minimum 5 years experience.

1.5 Project Conditions:

A. Verify field measurements are as shown on Drawings.

B. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.

C. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.
PART 2 PRODUCTS

2.1 Conductors (600V and below):

A. Description: Single conductor insulated wire.

B. Conductor: Copper

C. Insulation Voltage Rating: 600 volts.

D. Conductor Identification:
   1. Color code feeders and branch circuits power/lighting in accordance with CEC, Article 310, using the following colors:

<table>
<thead>
<tr>
<th>208V/120 VOLT</th>
<th>120/240 VOLT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>Black</td>
</tr>
<tr>
<td>Phase 2</td>
<td>Red</td>
</tr>
<tr>
<td>Phase 3</td>
<td>Blue</td>
</tr>
<tr>
<td>Neutrals</td>
<td>White</td>
</tr>
<tr>
<td>Ground</td>
<td>Green or Bare</td>
</tr>
</tbody>
</table>

   2. Color coding of ends only, of feeders, will be acceptable.

E. Insulation:
   1. Feeders and Branch Circuits Larger Than 4 AWG: Type THHN/THWN or XHHW.
   2. Feeders and Branch Circuits 6 AWG and Smaller: Type THHN/THWN.

F. Stranding:
   1. #8 AWG and larger; stranded, Class B.
   2. Totally within panels or cabinets; stranded, Class B
   3. Hinged wiring; extra flexible stranding, Class C

G. Equipment Grounding Conductors:
   1. CEC, Articles 210, 215, and 250.

2.2 Wiring Connectors:

A. Spring Wire Connectors:
   1. 3M Model Scotchlok or Hyflex
   2. Buchanan.
   3. Burndy.
   4. Elastimold;
   5. Ideal Model Wingnut or Wirenut.
   6. T&B.
B. Compression Connectors:
   1. Type with prestressed insulation to equal insulation of wire being installed.
   2. Conform to UL 486A.

C. Power Conductors Splicers:
   1. Blackburn.
   2. Burndy "Hylug".
   3. Ilsco.
   4. O.Z. Gedney.

D. Terminals:
   1. Insulated Type; rated 600 volts, 105 degrees C.
   2. Ring, locking spade, or pin type as appropriate for connection.
   3. Manufacturer:
      a. T&B.
      b. Panduit.

E. Insulating Tape.
   1. Conform to UL 510.

F. Cable Ties.
   1. 3M.
   2. Scotchflex #760.
   3. T&B "Tyrap".

2.3 Communications Data Cable:
   A. Communications Data Cable for PLC and Remote I/O Network: Type recommended by the equipment manufacturer.
   B. Provide shielding, if required to prevent interference from data cables installed in the same conduits as other intercom and low-level dc signal cables.

2.4 Pulling Lubricant:
   A. Type approved by the wire/cable manufacturer.

PART 3 EXECUTION

3.1 Examination:
   A. Verify that interior of building has been protected from weather.
   B. Verify that mechanical work likely to damage wire has been completed.
   C. Verify raceway system is completed prior to pulling wiring.
3.2 Preparation:
   A. Completely and thoroughly swab raceway before installing wire.

3.3 Installation:
   A. Install products in accordance with manufacturers instructions.

   B. Application:
      1. Use conductor not smaller than 12 AWG for power and lighting branch circuits.
      2. Exception: Fixture conductors shall not be smaller than 18 AWG in accordance with CEC, Article 410.
      3. Use conductor not smaller than 14 AWG for control circuits, unless otherwise indicated.
      4. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet. Use same size wire for entire circuit, except for taps.
      5. Use 8 AWG conductors for 20 ampere, 240 volt branch circuits longer than 200 feet. Use same size wire for entire circuit, except for taps.
      6. Install all wiring in raceway. Lighting and receptacle home runs indicated are for identification purposes only.
      7. Up to three branch circuits may be carried on one neutral leg in accordance with CEC, Article 210. In such cases, the neutral shall be one trade size larger than the phase conductors.
      8. Install panelboard and motor feeders in dedicated raceways.

   C. Pulling Wire
      1. Verify conduit is clean before pulling cable.
      2. Utilize pull rope for pulling in cable.
      3. Pull all conductors into raceway at same time.
      4. Use pulling lubricant for building wire 4 AWG and larger.
      5. Install feeder cables in one continuous length.
      6. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
      7. Utilize pullboxes and junction boxes for pulling cable.

   D. Connections:
      1. Neatly train and lace wiring inside boxes, equipment, and panelboards.
      2. Clean conductor surfaces before installing lugs and connectors.
      3. Make splices, taps, and terminations to carry full capacity of conductors with no perceptible temperature rise.
      4. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
      5. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
      6. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
7. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

8. Tighten screws to the value recommended by the manufacturer.

9. In the absence of manufacturer’s recommendations for torque settings, tighten screws to the values shown in UL 486A.

10. Provide and use terminals for control wiring terminations.

3.4 Field Quality Control:

A. Inspect wire for physical damage before and after installation; Terminate in accordance with CEC Article 110.

B. Measure tightness of bolted connections and compare torque measurements with manufacturer’s recommended values. Mark properly torqued connection with a line in black ink.

C. Verify continuity of each branch circuit conductor.

D. Meggar test and record all feeder conductors.

E. Replace conductors failing test.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation

Full compensation for furnishing labor, material, tools, equipment and incidentals for doing all work involved in Conductors (600V and below) as shown on the Plans, as specified in these Technical Specifications and as directed by the Owner’s Representative, shall be included under the Contract items per linear foot of pipe and no additional compensation will be allowed therefor.

END OF SECTION

4120
SECTION 4125
ELECTRICAL PULLBOXES

PART 1 GENERAL

1.1 Summary:
A. Section Includes:
   1. Precast Concrete Manholes, Handholes and Pullboxes (MHP).

B. Related Sections:
   1. Section 06100 - Electrical
   2. Section 06110 - Conduit.

1.2 References:

1.3 Definitions:
A. Handhole: An access opening provided in equipment or enclosure in connection with underground lines, into which personnel reach but do not enter. Handhole opening is used for the purpose of hand-access installation, operation, or maintenance.

B. Manhole: An access opening or an enclosure (generally subsurface) into which personnel may enter. Manhole opening is used for the purpose of full-physical-access installation, operation, and maintenance.

C. Pullbox: A box with a blank cover that is inserted into one or more runs of raceway to facilitate installation (pulling) of the conductors. Pullboxes may also serve the purpose of distributing the conductors.

1.4 Submittals:
A. Product Data: Provide dimensions, Knockout sizes and locations, materials and accessories.

B. Submit documentation confirming compliance with Regulatory Requirements in accordance with Section 01220.

PART 2 PRODUCTS

2.1 Pullboxes:
A. Acceptable Manufacturers:
   1. Associated Concrete Products, Inc.
   2. Brooks Products, Inc.
   3. Christy Concrete Products, Inc.
a. Christy catalog numbers indicated.

B. Pullbox:
1. Telephone Box.
2. Minimum internal size 17-3/4” by 30”.
3. Reinforced concrete with end knock outs.
4. Provide extensions as required so conduits come straight into box.
5. Reinforced concrete lid.
6. Traffic rated in paved areas.
7. Christy P36 series or equal for non-traffic areas.

PART 3 EXECUTION

3.1 Installation:
A. Do not install until final conduit grading, including field changes, has been determined. Set frames to final grades as required.
B. Install so that raceways will enter at nearly right angles and as near as possible to one end of a wall, unless otherwise indicated.
C. Install one ground rod in each installation. Connect all non-current carrying metal parts in handhole and any metallic raceway grounding bushings to this ground rod with copper conductor.

3.2 Duct Bank/Raceway Identification:
A. In each handhole provide a duct bank or raceway identification stating destination of a duct or conduit run.
B. Identification shall be made using permanent black ink stenciled in 2-inch-high letters.
   1. Where ducts/conduits are too close together to permit stenciling, provide mylar key attached to wall.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation
Full compensation for furnishing labor, material, tools, equipment and incidentals for doing all work involved in Electrical Pull Boxes as shown on the Plans, as specified in these Technical Specifications and as directed by the Owner’s Representative, shall be included under the Contract items per linear foot of pipe and no additional compensation will be allowed therefor.

END OF SECTION
4125
PART 1 GENERAL

1.1 Summary

A. Section includes:
   1. Outlet boxes.
   2. Pull and junction boxes.

B. Related Sections:
   1. Section 07900 - Joint Sealers
   2. Section 08110 - Metal Doors and Frames

1.2 References

A. American National Standards Institute (ANSI)
   1. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
   2. ANSI/NEMA OS 1 – Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
   3. ANSI/NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.


C. NEMA 250 - Enclosures For Electrical Equipment (1000 Volts Maximum).

D. Underwriters Laboratories Inc. (UL)
   1. UL 514A - Metallic Outlet Boxes.
   2. UL 886 - Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

1.3 As-Built Documents

A. Accurately record actual locations and mounting heights of all boxes.

1.4 Quality Assurance

A. Regulatory requirements:
   1. Furnish products listed and classified by UL as suitable for purpose specified and shown.
   2. Compliance with CEC with particular attention to Article 110.

1.5 Project Conditions

A. Verify field measurements are as shown on the drawings.
B. Boxes are indicated in approximate locations unless dimensions are shown. Verify locations prior to rough-in.

C. Coordinate mounting heights and locations of boxes mounted above, below, in, or on counters, benches and backsplashes.

D. Coordinate cutting of masonry to achieve neat installation.

E. Coordinate box locations with manufacturers of precast concrete items.

F. In framed ceilings, coordinate locations and sizes of required access doors with Section 08110.

PART 2 PRODUCTS

2.1 Outlet Boxes

A. Sheet Metal: Ansi/Nema Os 1, Galvanized Steel.
   1. Manufacturers:
      a. Appleton, Bowers, Raco, and Steel City.
   2. Concrete/Masonry Boxes: Concrete/Masonry Type.

B. Cast Boxes:
   1. Manufacturers:
      a. Crouse Hinds

C. Hazardous Locations: Ul 886.

2.2 Pull and Junction Boxes

A. Sheet Metal Boxes: Nema Os 1, Galvanized Steel.

B. Surface-Mounted: Nema 250, Type 4; Flat-Flanged.
   1. Material: Galvanized cast iron or steel.
   2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

PART 3 EXECUTION

3.1 Product Application

A. Exterior:
   1. In-ground: Where any type of splice or device is located, provide in-ground cast metal box with cover.
   2. Above-ground:
      a. Wet Locations: NEMA Type 4 enclosure or box.
B. Interior Finished Areas: Provide flush-mounting boxes.

C. Interior Unfinished Areas: Provide flush or surface-mounted boxes, except that exposed surface mounted boxes will not be acceptable in inmate accessible areas.

D. Pull boxes larger than 100 cubic inches in volume or 12 inches in any dimension:
   1. Exterior - weatherproof rated

3.2 Installation

A. Provide boxes as indicated, and as required by the CEC.

B. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.

C. Do not install flush mounting boxes back-to-back in walls.
   1. Maintain minimum 24 inches separation between boxes in acoustic and fire-rated walls.
   2. Maintain minimum 6 inch separation between boxes in other locations.

D. Provide boxes for luminaires and electrical connections to equipment shown on drawings.

E. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.

F. At stud walls and partitions, install box and plaster ring allowing for thickness of surface finish.

G. At access in ceilings, install boxes not more than 6 inches horizontally from panel opening or removable recessed luminaire.

H. Outlet boxes:
   1. Minimum Size: 4 inches square; 2-1/2 inches deep at ceilings; 3-2 inches deep at walls.
      a. Exception; 2-1/2 inches deep box allowed if rebar or other obstructions prevents the use of deeper boxes.
      b. Exception; single gang 3-1/2 inch deep boxes shall be used in masonry walls when single gang backing plates for single gang security devices plates are provided by others.
   2. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.
   3. At stud walls and partitions, install box and plaster ring allowing for thickness of surface finish.
   4. Provide boxes for luminaries and electrical connections to equipment shown on Drawings.
   5. For 1-gang outlet in non-masonry walls, use four inch square box with four inch square plaster ring with 1-gang opening.
   6. Boxes smaller than four inch square not permitted.
7. For 2-gang outlet, use four inch square box with four inch square plaster ring with 2-gang opening.
   a. When normal and emergency circuits in same box, provide barrier between them.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation

Full compensation for furnishing labor, materials, tools, equipment and incidentals for doing all work involved in Outlet Boxes as shown on the Plans, as specified in these Technical Specifications and as directed by the Owner’s Representative, shall be included under the Contract items to which work relates and no additional compensation will be allowed therefor.

END OF SECTION

4130
SECTION 4140
WIRING DEVICES

PART 1 Summary

A. Section Includes:
   1. Wall switches.
   2. Receptacles.
   3. Device plates and decorative box covers.

B. Related Sections:
   1. Section 06100 – Electrical.
   2. Section 06125 – Electrical Pullboxes.

1.2 References


B. National Electrical Manufacturers Association (NEMA)
   1. NEMA WD 1 - General Purpose Wiring Devices.
   2. NEMA WD 6 - Wiring Device Configurations.

1.3 Submittals

A. Manufacturer's Instructions:
   1. Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory requirements contained in Section 06100.
   2. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.

B. Certify compliance with CEC Article 110 - Requirements for Electrical Installations.

1.4 Extra Materials

A. Provide two of each style, size, and finish wall plate.

PART 2 PRODUCTS

2.1 Wall Switches:

A. Manufacturers:
   1. Hubbell
   2. Bryant
   3. Pass and Seymour
   4. General Electric
5. Slater  
6. Arrow-Hart  
7. Sylvania  
8. Leviton  

B. Description: NEMA WD 1, heavy-duty, AC only general-use snap switch, specification grade.

C. Device Body: Ivory plastic with toggle handle; unless otherwise indicated on the drawings.

D. Indicator Light: Separate pilot strap; red color lens.

E. Voltage Rating: 120-277 volts, AC.

F. Current Rating: 20 amperes.

G. Ratings: Match branch circuit and load characteristics.

H. Typical Switches:
   2. Double-pole: Hubbell 1222-I.
   3. Three-way: Hubbell 1223-I.
   4. Four-way: Hubbell 1224-I.
   5. Single-pole key switch: Hubbell 1221-L.
   6. Switches with pilot light in red toggle handle:
      a. Handle to light when switch is on.
      b. Hubbell 1221-PL.
   7. Narrow switches for hollow metal jamb posts:
      a. Arrow Hart No. QST-91I, with mounting strap No. 1657.

I. Weatherproof Switches: Where switches are indicated on Drawings as "WP", the switches shall be of the types specified above, mounted in cast metal box with gasketed weatherproof device plate.

2.2 Receptacles

A. Manufacturers:
   1. Hubbell  
   2. Arrow-Hart  
   3. Pass & Seymour  
   4. General Electric  
   5. Slater  
   6. Bryant  
   7. Sylvania
8. Leviton Spec-Master series (with nylon face).

B. Description: NEMA WD 1; heavy-duty general-use receptacle.

C. Device Body: Ivory, unless otherwise indicated, plastic.

D. Configuration: NEMA WD 6; type as specified and indicated.

E. Use red devices on "emergency" circuits.

F. Refer to symbol legend, Hubbell Nos. listed unless otherwise noted.

G. Receptacle Outlet; Duplex: 20A, 125V, 2 pole, 3 wire grounding, NEMA 5-20R; ivory (5362-I), red (5362-R).

H. Receptacle Outlet; Simplex: 20A, 125V, 2 pole, 3 wire grounding; NEMA 5-20R; ivory (5361-I), red (5361-I).

I. Weatherproof GFCI Receptacle Outlet: 20A, 125V, 3 wire grounding, duplex, with cast metal double lift cover plate for Type "FS" cast metal boxes, including gasket; Hubbell WPFS26.

J. GFCI Type Duplex Receptacle Outlet: Built-in ground-fault circuit interruption, 5-mA sensitivity, with indicator and reset button; UL listed; standard model for ground-fault protection at individual location; feed-through model for ground fault protection of "downstream" conventional receptacles.
   1. 20A, 125V, 3 wire duplex: NEMA 5-20R ivory (Arrow Hart GF5242-I), red (Arrow Hart GF5242-R).

K. Special Purpose Receptacle Outlet A: 20A, 250V, 2 pole, 3 wire grounding, side and back wired, single: NEMA 6-20 R; ivory (5461-I).

2.3 Device Plates

A. Device plates for concealed wiring: Same manufacturer as wiring devices, to suit device covered, single or ganged, in one piece with beveled edges that match faces of plates.
   1. Metal.

PART 3 EXECUTION

3.1 Examination

A. Verify conditions under provisions of Division 1.

B. Verify outlet boxes are installed at proper height.

C. Verify wall openings are neatly cut and will be completely covered by wall plates.

D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.
B. Clean debris from outlet boxes.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Install products in accordance with CEC.
C. Install devices plumb and level.
D. Install switches with OFF position down.
E. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
F. Do not share neutral conductor on load side of dimmers.
G. Install receptacles with grounding pole on bottom.
H. Except for devices on isolated ground circuits, connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor if present.
I. For isolated ground circuits, connect ground wire directly to device.
J. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
K. Connect wiring devices by wrapping conductor around screw terminal.
L. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
M. Center outlets with regard to paneling, furring, trim, etc.
N. Where several outlets occur in a room, symmetrically arrange them.
O. Set outlets plumb or horizontal and extending to finished surface of wall, ceiling or floor as case may be without projecting beyond same.
P. Install wall switch 42 inches above finished floor.
Q. Install convenience receptacle in mechanical rooms 48 inches above finished floor.
R. Install convenience receptacles in locations not specified above at 18 inches above floor.
S. Install dimmer 42 inches above finished floor.
T. Where GFI receptacles are indicated, install GFI receptacles at each location. Use of a GFI receptacle to protect downstream receptacles is not permitted unless otherwise indicated. Do not use GFI circuit breakers unless specifically indicated.
3.4 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 16130 to obtain mounting heights specified unless otherwise indicated on Drawings. All dimensions are to the center of the item.

3.5 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.
B. Operate each wall switch with circuit energized and verify proper operation.
C. Verify that each receptacle device is energized.
D. Test each receptacle device for proper polarity.
E. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation

Full compensation for furnishing labor, materials, tools, equipment and incidentals for doing all work involved in Wiring Devices as shown on the Plans, as specified in these Technical Specifications and as directed by the Owner’s Representative, shall be included under the Contract Bid items to which this work relates and no additional compensation will be allowed therefor.
PART 1 GENERAL

1.1 Summary

A. Section Includes
   1. Grounding electrodes and conductors.
   2. Equipment grounding conductors.

B. Related Sections
   1. Section 06100 - Electrical.

1.2 References


1.3 Grounding Electrode System Description

A. The following only shall be acceptable grounding electrodes:
   1. Concrete-encased electrode.
   2. Ground ring.
   3. Rod electrode.

1.4 Performance Requirements

A. Grounding System Resistance:
   1. Separately Derived Sources grounding electrode: 10 ohms.

1.5 Submittals

A. Submit under provisions of Section 01220.
B. Certify compliance with CEC Article 110 - Requirements for Electrical Installations.
C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
D. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation and installation of exothermic connectors.

1.6 As-Built Documents

A. Accurately record actual locations of grounding electrodes.
PART 2 PRODUCTS

2.1 Rod Electrode
   A. Material: Copper-clad steel.
   B. Diameter: 3/4 inch.
   C. Length: 10 feet.

2.2 Mechanical Connectors
   A. Manufacturers:
      1. Burndy.
   B. Material: Bronze.

2.3 Exothermic Connections
   A. Manufacturers:
      1. Burndy.
      2. Cadweld.

2.4 Wire
   A. Material: Stranded copper.
   B. Foundation Electrodes: 2/0 AWG.
   C. Grounding Electrode Conductor: As indicated or per CEC Article 250, whichever is larger.

2.5 Grounding Well Components
   A. Well Pipe: 11 x 17 x 12 inch square clay tile or concrete pipe with belled end.
   B. Well Cover: Cast iron with legend "GROUND" embossed on cover.

2.6 Grounding Clamps
   A. Manufacturers:
      1. Burndy.

PART 3 EXECUTION

3.1 Examination:
   A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 Installation:
   A. Install Products in accordance with manufacturer’s instructions.
B. Grounding Electrodes
   1. Install rod electrodes at locations indicated.
   2. Install additional rod electrodes as required to achieve specified resistance to ground.
      a. Install additional rods a minimum of 5 ft from other rods.
      b. Notify Owner’s Representative if performance requirements have not been met after 5 additional rods have been installed.
   3. Provide grounding well pipe with cover at rod locations where indicated. Install well pipe top flush with finished grade.
   4. All buried connections and connections to ground rods shall be exothermic.
   5. Install bare copper wire in foundation footing where indicated.
   6. Install other grounding electrodes as indicated on the single line diagram, and other drawings.

C. Grounding Electrode Conductor
   1. Install grounding electrode conductor in steel conduit and connect to grounding electrode system with suitable lugs, pressure connectors, clamps or other approved means.
      a. Unless otherwise indicated, install main ground unspliced in exposed conduit.
      b. Make connections easily accessible for inspection, not underground or concealed in floors or walls.
      c. Provide grounding electrode system in accord with CEC.
   2. Bond grounding conductor to conduit at entrance and exit, of same type and quality as other conductors in building.
   3. Ground all neutral conductors, conduit systems, cabinets, equipment, motor frames, etc., in accord with CEC and applicable codes.

D. Bonding
   1. Provide bonding to meet CEC.
   2. Bond the interior metallic water system to the grounding system.
   3. Bond together metal siding not attached to grounded structure; bond to ground.

E. Grounding Conductors
   1. Provide isolated grounding conductor for circuits indicated.
   2. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder circuit raceway and within each branch circuit which is all or in part in nonmetallic conduit. Terminate each end on suitable lug, bus, or bushing.
   3. Provide grounding conductor in non-metallic conduit.
   4. Provide separate grounding conductor in flexible steel conduit.
   5. Locate neutral ground disconnecting link or links in service panelboard or switchboard so that low-voltage neutral bar with all interior secondary neutrals can be isolated from common equipment grounding bus.

F. Grounding Connections
1. Ground shields of shielded power cable and signal cable at each splice or termination in accordance with recommendations of the splice or termination manufacturer.

2. Ground metal sheathing and exposed metal vertical structural elements of buildings. Ground metal fences enclosing electrical equipment. Bond any metal equipment platforms which support electrical equipment to that equipment. Provide good electrical contact between metal frames and railings supporting pushbutton stations, receptacles, instrument cabinets, etc., and raceways carrying circuits to these devices.

3. Ground all fencing as shown on the grounding details on the Drawings.

4. Bond neutrals of transformers within buildings to the system ground network, and to additional indicated grounding electrodes.

5. Unless shown otherwise, make connections of grounding conductors to ground rods at the upper end of the rod with the end of the rod and the connection point below finished grade.

6. Make connections of sections of outdoor ground mats (counterpoise) for substations or other equipment underground.

7. Make connections of other grounding conductors generally accessible.

8. In manhole pullboxes, install ground rods with ends 4 to 6 inches above the floor with connections of grounding conductors fully visible and accessible.

9. When making thermite welds, wire brush or file the point of contact to a bare metal surface. Use thermite welding cartridges and molds in accordance with the manufacturer's recommendations. After welds have been made and cooled, brush slag from the weld area and thoroughly clean the joint. Regalvanize area if required. For compression connectors, use homogeneous copper, anti-corrosion, surface treatment compound at connectors in accordance with connector manufacturer's recommendations. Use connectors of proper size for conductors and ground rods specified. Use connector manufacturer's compression tool. Notify the Owner's Representative prior to backfilling any ground connections.

10. Grounding pad plates shall be cast into the slab with the surface flush with the finished floor.

3.3 Field Quality Control

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

B. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.

C. Notify Owner's Representative five days before inspection and testing.

D. Record test results and submit.
PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation

Full compensation for furnishing labor, materials, tools, equipment and incidentals for doing all work involved in Grounding as shown on the Plans, as specified in these Technical Specifications and as directed by the Owner’s Representative, shall be included under the Contract Bid items to which this work relates and no additional compensation will be allowed therefor.

END OF SECTION
4150
SECTION 4160
EQUIPMENT WIRING SYSTEMS

PART 1 GENERAL

1.1 Summary

A. Section Includes
   1. Electrical connections to equipment specified under other sections.

B. Related Sections
   1. Section 06100 - Electrical.
   2. Section 06110 - Conduit.
   3. Section 06120 - Conductors (600V and Below).
   4. Section 06130 – Outlet Boxes.
   5. Section 06140 - Wiring Devices.

1.2 References


B. National Electrical Manufacturers Association (NEMA)
   1. NEMA WD 1 - General Purpose Wiring Devices.
   2. NEMA WD 6 - Wiring Device Configurations

1.3 Submittals

A. Submit under provisions of Division 1.

B. Certify compliance with CEC Article 110 - Requirements for Electrical Installations.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements contained in Section 06100. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

D. Provide interconnection drawing. Prior to pulling any wire all interconnection shall be approved.

1.4 Coordination

A. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.

B. Determine connection locations and requirements.

C. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
D. Sequence electrical connections to coordinate with start-up schedule for equipment.

PART 2 PRODUCTS

2.1 Cords and Caps

A. Attachment Plug Construction: Conform to NEMA WD 1. Provide plug equivalent in quality to receptacles provided under Section 06140.

B. Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.

C. Cord Construction: CEC, Type SO multi-conductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations. Minimum construction shall be 3 conductor, 12 AWG conductors.

D. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 EXECUTION

3.1 Examination

A. Verify that equipment is ready for electrical connection, wiring, and energization.
   1. Conduit system fitting shall be in accordance with Section 06110.
   2. Wiring and cabling shall be in accordance with Section 06120.
   3. Boxes shall be furnished and fitted in accordance with Section 06130.

3.2 Electrical Connections

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Provide and install conduit in accordance with Section 06110.

C. Provide and install wire in accordance with Section 06120.

D. Provide and install boxes in accordance with Section 06130.

E. Provide and install receptacle outlets in accordance with Section 06140.

F. Make conduit connections to equipment using flexible conduit. Use liquid-tight flexible conduit with watertight connectors in damp or wet locations.

G. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.

H. Provide and install receptacle outlet in accordance with Section 16141, where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.
I. Provide and install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

J. Provide and install disconnect switches, controllers, control stations, and control devices as indicated.

K. Modify equipment control wiring with terminal block jumpers as indicated.

L. Provide interconnecting conduit and wiring between devices and equipment where indicated.

M. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

3.3 Interface with Other Products

A. Other Sections that have mechanical equipment to be connected to under this Section include, but are not limited to those shown on plans.

3.4 Equipment Connection Schedule

A. See drawings for schedule.

3.5 Testing

1. Demonstrate correct equipment operation to the Owner’s Representative.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation

Full compensation for furnishing labor, materials, tools, equipment and incidentals for doing all work involved in Equipment Wiring Systems as shown on the Plans, as specified in these Technical Specifications and as directed by the Owner’s Representative, shall be included under the Contract Bid items to which this work relates and no additional compensation will be allowed therefor.

END OF SECTION

4160
PART 1 GENERAL

1.1 Summary:
   A. Section Includes
      1. Equipment supports.
      2. Raceway supports.
      3. Anchors and fasteners.
   B. Related Sections
      1. Section 06100 - Basic Electrical Requirements.

1.2 References
   A. ASTM A36 - Carbon Structural Steel.

1.3 Submittals
   A. Submit under provisions of Section 01220.
   B. Indicate hanger and support framing and attachment methods.
   C. Submit seismic and structural calculations.

1.4 System Description
   A. Design Requirements:
      1. Hangers and supports shall have minimum safety factor of five (5), based on ultimate tensile or compressive strength, as applicable, of material used.
      2. Anchors shall be applied in accordance with the ANCHOR CAPACITY TABLE following paragraph 3.2.

PART 2 PRODUCTS

2.1 Product Requirements:
   A. Materials and Finishes: Provide corrosion resistance that provides as a minimum the same protection as the products being supported.
   B. Provide materials, sizes and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire equal to full capacity of raceway in calculations for supports.
   C. Anchors and Fasteners.
1. Sheet Metal Screws: Steel.
3. Precast Inserts: Suitable for the purpose.
4. Anchor bolts, expansion type.
7. Cast-in-Place Anchors: Suitable for the purpose.
8. Beam Clamps: Steel.

D. Raceway Supports
1. Conduit Straps Used with Rigid Steel Conduit: One hole malleable iron, cadmium plated.
2. Conduit Straps Used with Other Than Rigid Steel Conduit: One or two hole steel, cadmium plated.
3. Clamp Backs: Steel, cadmium plated.
4. Patented Type Fasteners
   a. Manufacturer:
      1) Erico; "Caddy".
      2) Fastway.
      3) B-Line.

E. Channels
1. Manufacturers
   a. Unistrut.
   b. Powerstrut.
2. Material
   a. 12 gauge steel, 1-5/8" by 1-5/8" when not attached to building surface.
   b. 14 gauge steel, 1-5/8" wide by 13/16" deep when connected directly to building surface.
   c. Hot-dip galvanized except cadmium plated in dry locations.
3. Fittings: By channel manufacturer.

F. Hanger Rods:
1. Material: 1/4" minimum hot-dip galvanized after fabrication.

G. Structural Steel:
2. Finish:
   a. Dry Locations: Shop coat of rust inhibiting primer.
b. Otherwise hot-dipped galvanized after fabrication.

H. Pipe Hangers: Hot dipped galvanized steel or malleable iron.

PART 3 EXECUTION

3.1 Installation

A. General
1. Install products in accordance with manufacturer's instructions.
2. Do not fasten supports to pipes, ducts, mechanical equipment and conduit.
3. Do not drill or cut structural members without approval of Owner's Representative.

B. Anchors
1. Concrete - Precast inserts, cast-in-place anchors or expansion type anchor bolts.
   a. When installing drilled-in anchors in non-prestressed reinforced concrete, avoid the reinforcing bars.
   b. When installing drilled-in anchors into prestressed concrete (pre- or post-tensioned), locate tendons by using a non-destructive method prior to installation. Maintain a minimum clearance of one-inch between the reinforcement and the drilled-in anchor.
2. Sheet Metal - Sheet metal screws or machine bolts, nuts and washers.
3. Structural Steel Members - Beam clamps, machine screws, bolts, nuts and washers.

C. Supports
1. Fabricate supports from structural steel or steel channel. Rigidly weld or bolt members to present a neat appearance with adequate strength and rigidity.
2. Vertical adjustment on threaded rods shall be with 2 nuts on each end for positioning and locking.

D. Conduit
1. In damp or wet locations, space conduit support directly from concrete or metal structure out at least 1/4" using straps with spacers or, if three (3) or more conduits are located in a parallel run, they shall be spaced out from the wall approximately 5/8" to 1" by means of channel.
2. Runs of individual conduit suspended from the floor or ceiling shall be supported with pipe hangers. Where three (3) or more conduits are suspended from the floor/ceiling, suitable racks shall be constructed from channel material with suitable fittings.
3. Space supporting points no greater than required in CEC.

E. Raceway Other Than Conduit
1. Service to structure in accordance with manufacturer's instructions.

F. Equipment
1. Install surface-mounted cabinets and panelboards with a minimum of four anchors.
2. In wet and damp locations use steel channel supports to stand cabinets and panelboards 13/16 inch minimum off wall.

3. Use sheet metal channels to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

4. Support equipment in accordance with manufacturer’s instructions.

5. Verify that equipment will fit support layouts indicated.
   a. Where substitute equipment is used, revise indicated supports to fit at no additional cost.

6. Arrange for necessary openings to allow entry of equipment.
   a. Where equipment cannot be installed as structure is being erected, provide and arrange for building-in of boxes, sleeves or other devices to allow later installation.

G. Sleeves
1. Set sleeves in position in formwork. Provide reinforcing around sleeves.

2. Extend sleeves through floors one inch above finished floor level. Calk sleeves full depth and provide floor plate.

3. Where raceway penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with [fire stopping] insulation and calk seal.

3.2 Field Quality Control

A. All expansion anchors shall have 50 percent of the bolts (alternate bolts in any group arrangement) proof tested in tension and certified by a recognized testing agency at the values indicated in the following table, except where shown otherwise on the drawings. If there are any failures, the immediately adjacent bolts must then also be tested. Anchor capacities shall not exceed 80% of the values in the published ICBO report.

ANCHOR CAPACITY
(3000 PSI MINIMUM STONE AGGREGATE CONCRETE)

<table>
<thead>
<tr>
<th>Units</th>
<th>1/2&quot;</th>
<th>5/8&quot;</th>
<th>3/4&quot;</th>
<th>7/8&quot;</th>
<th>1&quot;</th>
<th>1-1/4&quot;</th>
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</thead>
<tbody>
<tr>
<td>IN TENSION</td>
<td>680</td>
<td>960</td>
<td>1,360</td>
<td>1,900</td>
<td>2,700</td>
<td>3,600</td>
</tr>
<tr>
<td>IN SHEAR</td>
<td>1,170</td>
<td>1,680</td>
<td>2,420</td>
<td>3,500</td>
<td>5,020</td>
<td>6,700</td>
</tr>
<tr>
<td>TYPE OF TEST:</td>
<td>DIRECT PULL-TENSION, LBS.</td>
<td>1,360</td>
<td>1,920</td>
<td>2,720</td>
<td>3,800</td>
<td>5,400</td>
</tr>
<tr>
<td></td>
<td>MINIMUM EMBEDMENT</td>
<td>3</td>
<td>3-3/4</td>
<td>4-1/2</td>
<td>5-1/4</td>
<td>6</td>
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<td>LBS</td>
<td></td>
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<tr>
<td>MINIMUM</td>
<td></td>
<td>INCHES</td>
<td></td>
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</tbody>
</table>
PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation

Full compensation for furnishing labor, materials, tools, equipment and incidentals for doing all work involved in Supporting Devices as shown on the Plans, as specified in these Technical Specifications and as directed by the Owner's Representative, shall be included under the Contract Bid items to which this work relates and no additional compensation will be allowed therefor.

END OF SECTION
4170
PART 1 GENERAL

1.1 Summary

A. Section Includes
   1. Nameplates.
   2. Wire markers.
   3. Conduit and electrical markers.
   4. Buried utility tape.

1.2 References


1.3 Quality Assurance

A. Regulatory Requirements
   1. Furnish products listed and classified by UL as suitable for purpose specified and shown.
   2. Compliance with the CEC and in particular, Article 110.

PART 2 PRODUCTS

2.1 Nameplates

A. Description:
   1. Nameplates: Engraved three-layer laminated plastic, white letters on black background.
   2. Letter Size:
      a. Use 1/8 inch letters for identifying individual equipment and loads.
      b. Use 1/4 inch letters for identifying grouped equipment and loads.

2.2 Wire Markers

A. Manufacturers:

B. Description:
   1. Vinyl cloth, self laminating vinyl, heat shrink sleeving, or tube type markers.
   2. Legend:
a. Power and Lighting Circuits: Branch circuit or feeder number shown on drawings.
b. Control Circuits: Control wire number shown on shop drawings.

2.3 Conduit and Electrical Markers

A. Manufacturers:

B. Description: Vinyl Tape, 2" wide.

C. Legend and Color:
   1. Black lettering on orange background:
      a. All voltages.
      b. Emergency electrical system, “EMERGENCY.”
   2. White lettering on red background:
      a. Fire alarm system, “FIRE.”
   3. White lettering on blue background:
      a. Telephone system, “TELE.”
      b. Spare communications, “SPARE.”

2.4 Buried Utility Tape

A. Manufacturers:

B. Description:
   1. Detectable plastic tape, 6 inch wide, colored red with warning legend: "HIGH VOLTAGE".

PART 3 EXECUTION

3.1 Preparation

A. Degrease and clean surfaces to receive nameplates, wire markers, conduit and electrical markers.

3.2 Application

A. Nameplates
   1. Provide nameplates for electrical equipment, such as distribution panels, sub panels, transformers, and disconnects.
      a. Install nameplate level in appearance to equipment front with metal screws.
   2. Recessed panelboards: Install nameplate with metal screws to inside surface of door.

B. Wire Markers.
1. Provide each conductor at panelboard, gutter, pull box, junction box, convenience outlet, cabinet, and each load connection.
   a. For feeder and branch circuits, use circuit numbers shown on the Drawings. For control circuits, use circuit numbers shown on the shop drawings.

C. Above Grade Conduit:
   1. Provide conduit/electrical markers for all exposed conduits, longer than 20 feet, which passes through a room or any open area without terminating.
      a. Mark conduit every 20 feet.

D. Below Grade Conduit or Utility Duct:
   1. Provide utility tape for entire length of conduit or duct.
      a. Install utility tape 12 inches maximum above conduit or duct.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation

Full compensation for furnishing labor, materials, tools, equipment and incidentals for doing all work involved in Electrical Identification as shown on the Plans, as specified in these Technical Specifications and as directed by the Owner's Representative, shall be included under the Contract Bid items to which this work relates and no additional compensation will be allowed therefor.

END OF SECTION

4180
SECTION 4200
LIGHTING

PART 1 GENERAL

1.1 Summary

A. Section Includes
   1. Interior luminaires and accessories.
   2. Building mounted exterior luminaires.
   3. Exit signs.
   4. Ballasts.
   5. Fluorescent lamp emergency power supply.
   7. Luminaire accessories.

B. Related Sections
   1. Section 06100 - Basic Electrical.
   2. Section 06110 - Conduit.

1.2 References

A. American National Standards Institute (ANSI)
   1. ANSI C78.379 - Electric Lamps - Incandescent and High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns.
   2. ANSI C82.1 - Ballasts for Fluorescent Lamps - Specifications.
   3. ANSI C82.4 - Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).


C. Energy Star - United States Environmental Protection Agency Energy Star Program.


E. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

F. Underwriters Laboratories, Inc. (UL)

1.3 Submittals

A. Submit under provisions of Section 01220.

B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
C. Product Data: Provide manufacturer dimensions, ratings, and performance data. Identify fixtures by luminaire schedule number.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

E. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Submit lighting level performance data where indicated as required or where an approval of a listed fixture is requested. Provide all assumptions. Indicate whether calculated or measured.

1.4 Operation and Maintenance Date

A. Submit under provisions of Section 01220.

B. Maintenance Data: Include replacement parts list.

1.5 Regulatory Requirements

A. Conform to requirements of CEC.

B. Conform to requirements of CBC.

C. Furnish products listed and classified by UL, or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

D. Comply with requirements for Energy Star labeled lighting (commercial) products.

1.6 Extra Materials

A. Provide 5 percent or two, whichever is greater of each plastic and other security lens type.

B. Provide 10 percent or one case, whichever is greater, replacement lamp for each lamp installed.

C. Provide 5 percent or two, whichever is greater of each ballast type.

1.7 Warranty

A. Provide warranty under provisions of Division 1.

PART 2 PRODUCTS

2.1 Luminaries - General:

A. Furnish products as specified in schedule.

   1. GENERAL: Lighting fixtures as hereinafter specified are identified by type as noted on drawings. Fixture specifications are based on construction and performance. Manufacturer's catalogue numbers are of general nature and indicate level of quality required, but do not necessarily reflect complete options as specified. Approval shall be based on description and specification of fixture as well as catalogue number.
indicated. See specifications for fixture, lens, lamp and ballast requirements. Verify ballast voltage requirements with circuitry indicated on drawings.

2. Fluorescent fixtures with self contained emergency battery packs to be U.L. labeled as “EMERGENCY LIGHTING UNITS”.

B. Substitutions: Submit performance calculations for proposed substitutions.

C. Install ballasts, and specified accessories at factory.

D. Provide all recessed fixtures with gaskets of rubber, fiberglass, or equivalent material to prevent light leaks around flush trim.

E. Provide incandescent recessed fixtures with trim gaskets cemented in proper position.

F. Provide standard plaster frame for all recessed lighting fixtures installed in plaster walls or ceilings.

G. Design, finish and fabricate material to preclude possibility of rust stain in plaster.

H. Coordinate fixture types with ceiling construction.

2.2 Ballasts

1. Fluorescent Ballast - Non-Dimming:
   a. Manufacturers:
   b. Valmont Model Performance Electronic.
   c. Advance Model Mark V Electronic.
   d. Magnatek Model Triad Electronic.

2. Description: ANSI C82.1, high power factor type electronic (Octron) ballast, ETL approved, UL labeled P.

3. Protected with two internal automatic resetting thermal switch devices for coil and capacitor.

4. Sound Level: 'A' for 430 MA or less lamps 'B' for 800 ma lamps and 'C' for 1500 MA lamps. Stamp rating on ballast.

5. Provide low temperature ballasts where installed in non-conditioned spaces. Ballasts shall operate to 0 degrees F.

6. Provide rapid start ballasts for lamps 25 watts and greater and trigger start ballasts for 20 watts and less.

7. Provide ballast suitable for lamps specified.

8. Voltage: Match luminaire voltage.

9. Source Quality Control: Certify ballast design and construction by Certified Ballast Manufacturers, Inc.

10. Comply with California Title 24 energy requirements.

11. Comply with requirements for Energy Star fluorescent ballast efficiency.

12. Electronic ballasts shall be provided within those lighting fixtures as follows:
   a. 1-Lamp Fixture: 1-lamp ballast.
   b. 2-Lamp fixture: 2-lamp ballast.
c. 3-Lamp Fixture: 3-lamp ballast or tandem wired.
d. 4-Lamp Fixture: One 4-lamp ballast or two 2-lamp ballasts where required for dual level switching applications.

13. Ballasts for compact fluorescent lamps shall be integral with the lamp.
14. Total Harmonic Distortion: 20 percent or less.
15. Current Crest Factor: 1.7 or less.

B. High Intensity Discharge (HID) Ballast:
1. Description: ANSI C82.4, metal halide or high pressure sodium lamp ballast as appropriate for luminaire.
2. Lead peaked constant wattage auto transformer, quiet-type encased and potted.
3. Provide ballast suitable for lamp specified.
4. Luminaire Efficacy Factor: No less than as recommended by FEMP.
5. Voltage: Match luminaire voltage.
6. UL approved high power factor.

2.3 Fluorescent Lamp Emergency Power Supply

A. Description: Emergency battery power supply suitable for installation in ballast compartment of fluorescent luminaire.

B. Lamp Ratings: One FO32 lamp providing 600 lumens, minimum.

C. Battery: Sealed nickel cadmium type, rated for 10 year life.

D. Include TEST switch and AC ON indicator light, installed to be operable and visible from the outside of an assembled luminaire.

2.4 Lamps

A. Compact Fluorescent Lamps (CFL)
1. All CFLs shall be packaged with an integral ballast.
2. Power Factor: Greater than 50 percent.
3. Color Rendering Index: 80 percent or above.
5. Energy Star labeled.

B. Fluorescent Tube Lamps:
1. Manufacturers:
   b. Sylvania.
   c. Philips.
1) All lamps shall be 4100K unless otherwise indicated. (Exception: 2700K acceptable for compact fluorescent lamps.)

2) All F032 lamps shall be T8 energy savings type unless otherwise indicated. All F96 lamps shall be T12 energy saving type. All F032 U-lamps shall be T8 energy saving type.

3) Comply with requirements for Energy Star energy-efficient tube lamps.

C. High Intensity Discharge (HID) Lamps:
   1. Manufacturers:
      b. Sylvania.
      c. Philips.
   2. All high pressure sodium lamps shall be clear.

D. Provide lamp type compatible with luminaire.

E. Reflector Lamp Beam Patterns: ANSI C78.379.

PART 3 EXECUTION

3.1 Examination

A. Examine substrate and supporting grids for luminaires.

B. Examine each luminaire to determine suitability for lamps specified.

3.2 Installation - General

A. Install in accordance with manufacturers instructions.

B. Mount lighting fixtures at heights indicated. Where not indicated mount:
   1. Exit lights - 90 inches above floor. Center in space over door frame where applicable.
   2. Bracket light above lavatory - 78 inches above floor.

C. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.

D. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

E. Where a switched fixture with battery backup is used, connect an unswitched lead to the emergency ballast.

F. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure.

G. Install recessed luminaires to permit removal from below.
H. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

I. Install clips to secure recessed grid-supported luminaires in place.

J. Install wall mounted luminaires and exit signs at height as indicated on Drawings.

K. Install accessories furnished with each luminaire.

L. Connect luminaires, and exit signs to branch circuit outlets provided under Section 16130 using flexible conduit as indicated.

M. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

N. Bond products and metal accessories to branch circuit equipment grounding conductor.

O. Install specified lamps in each luminaire, emergency lighting unit and exit sign.

P. Maintain fire rating of ceiling where luminaire are installed.

3.3 Field Quality Control

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.4 Adjusting

A. Adjust Work under provisions of Division 1.

B. Aim and adjust luminaires as indicated on Drawings as directed.

C. Adjust exit sign directional arrows as indicated.

D. Relamp luminaires that have failed lamps at Substantial Completion.

3.5 Cleaning

A. Clean Work under provisions of Division 1.

B. Clean electrical parts to remove conductive and deleterious materials.

C. Remove dirt and debris from enclosure.

D. Clean photometric control surfaces as recommended by manufacturer.

E. Clean finishes and touch up damage.

3.6 Adjust

A. After cleaning, adjust, focus and aim luminaire to provide even light in area illuminated.

3.7 Demonstration

A. Provide systems demonstration under provisions of Division 1.
B. Provide minimum of two hours demonstration of luminaire operation.

3.8 Luminaire Schedule

A. As indicated on the drawings.

B. Reflector Lamp Beam Patterns: ANSI C78.379.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation

Full compensation for furnishing labor, materials, tools, equipment and incidentals for doing all work involved in Lighting as shown on the Plans, as specified in these Technical Specifications and as directed by the Owner's Representative, shall be included under the Contract Bid items to which this work relates and no additional compensation will be allowed therefor.

END OF SECTION
4200
PART 1 GENERAL

1.1 Scope of Work

A. Provide and install Power Distribution and Control Panels (all plans) per drawings.

B. Provide complete wired and tested panel with all devices installed per the contract drawings and as stated herein.

C. Provide all necessary hardware, conduit, wiring, fittings, and devices to connect the control panel to equipment provided under other Sections.

1.2 Related Sections

A. Section 06100 - Electrical

B. Section 06110 - Conduit

C. Pullboxes

1.3 Submittal Requirements

A. Provide submittals and drawings as specified.

B. Submit shop construction drawings for the Power Distribution and Control Panels. The following drawings shall be provided as a minimum:
   1. Scaled drawings of the Power Distribution and Control Panels elevation, basepan. The dimensions and locations of the cutouts shall be dimensioned from the bottom left corner of the door(s).
   2. Scaled drawings of the backpan including all mounted components and wireways.
   3. Wiring diagrams for AC and DC power distribution, I/O for each card in the PLC and communications block diagrams.
   4. Interconnection diagrams per Section 06100.

PART 2 PRODUCTS

2.1 Control Panel Specifications

A. Enclosure: Furnish and install all equipment as shown on drawings U.L. listed for indoor installation which consists of switch board, MRCE/ in panels that control panel switchboard and instrument pedestal. Enclosure shall consist of a TESCO Class 24-000 section, or pre-approved equal, with dead front interior and hinged gasketed exterior doors. Outer enclosure shall be constructed of 12 gauge hot dipped galvanized steel. Doors shall be equipped with 316 stainless steel handles with 3-point roller bearing latches and hasps for owner padlocks. Concrete base with anchor bolts to meet applicable seismic requirements shall be provided. Provide GFCI receptacle, PFR power fail relay, strip heater, and
thermostat. Seal all openings to prevent entrance of insects and rodents. Finish shall be polyester dry powder, electrostatically applied and baked on at 380 deg. F. The painting process shall include five stages of metal preparation using dip tanks as follows: 1) Alkaline cleaner, 2) Clear water rinse, 3) Iron phosphate application, 4) Clear water rinse, and 5) Inhibitive rinse to seal phosphated surfaces. All bussing and wire shall be copper. All wire shall be stranded with locking spade pressure connectors and labeled with clip-on permanent plastic wire markers. All circuit breakers and dead front mounted devices (lights and switches) shall be equipped with engraved phenolic nameplates. The enclosure and custom sun/heat shields shall be painted “Autumn White” to minimize the heat effects of direct sunlight. An air conditioner shall be mounted on the enclosure as well to maintain optimum operating temperature conditions.

The enclosure shall be compartmentalized such that the programmable pump controller and power sections are isolated from each other. The compartments containing the programmable pump controller and power sections shall be separated by barriers behind the inner dead front door. Doors shall be hinged on the same side and shall open to greater than 90 degrees. All dead front latches are 1/4 turn adjustable with 1/8" thick latching dog and knurled knob.

B. Circuit Breakers: All 480 volt circuit breakers shall have interrupting capacities at 65,000 amperes. All 120 volt breakers shall be rated 10,000 amperes interrupting capacity. Circuit breakers shall be of the indicating type, providing ON, OFF and TRIPPED positions of the operating handle. Circuit breakers shall be quick-make, quick-break, with a thermal-magnetic action, except when protecting motor feeders where motor circuit protector (MCP) breakers may be used. Circuit breakers shall be the bolted on type. The use of tandem or dual circuit breakers in a normal single- pole space to provide the number of poles or spaces specified is not acceptable. All multiple-pole circuit breakers shall be designed so that an overload on one pole automatically causes all poles to open. Circuit breakers shall meet the requirements of UL and NEMA AB1.

C. Grounding System: The switchboard ground bus and incoming neutral service conductor shall be connected to a "rod" type "ground". The ground rod shall be 3/4" x 10' copper clad with connection made by exothermic weld and driven in earth at base of pedestal. The ground rod shall extend up into pedestal for visible connection with an approved "exothermic weld". Grounding and bonding wires shall be installed in all PVC conduit runs and connected to ground bus and all equipment.

1. Thermite welding materials shall be of size and type recommended by the manufacturer for the intended use.

2. Grounding conductor - All grounding conductor shall be sized as shown on plans or in accordance with NEC Table 250-95, whichever is larger.

3. Ground bus - A ground bus shall be provided in the service equipment. It shall be connected to the grounding electrode system by exothermic welded stranded copper grounding conductors. Screw type lugs shall be provided for connection of equipment grounding conductors.

D. Motor Controls, General: Provide each motor with a suitable controller and devices that will perform the functions as specified for the respective motors. Controllers shall conform to the applicable requirements of NEMA ICS, ANSI C19.1, the NEC, and UL. Anticipated horsepower ratings and enclosures are shown on the plans. This information is for guidance only and does not limit the equipment size. When motors furnished differ from the expected ratings indicated, make the necessary adjustments to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate the motors actually installed, at no additional cost to the Owner.
Each motor control system shall be equipped with a hand-off-auto control switch, indicating lights, elapsed time meter, motor starter, control transformer with primary fuses and secondary control power fuse.

1. Control switches and indicating lights shall be U.L. listed oil-tight devices rated heavy duty.

2. Elapsed time meters shall be non-resettable with 0.0 to 99,999.9 readout.

3. Motor starters shall be NEMA rated with an electrically held contractor and a single reset, 3 phase, overload relay with a normally closed holding contact and a normally open isolated contact for overload alarm. Each overload shall be ambient compensated and shall trip on 600% of full load current in less than 6 seconds. Each motor starter Size 3 and larger shall be furnished with a minimum of 4 auxiliary contacts and provisions for adding 2 more. Auxiliary contacts shall be convertible in the field from normally open to normally closed. Each overload relay shall have a test trip push-button built-in and an adjustable calibrated trip with indicating dial. There shall be an unbreakable steel operator, with insulated plastic foot (for safety) through the front door for manual reset.

4. Control power transformers shall be sized as shown on the plans, minimum size shall be 100VA where not designated.

E. Nameplates: Nameplates shall be black phenolic with white lettering. Nameplates shall be screw mounted. Glue type will not be acceptable.

F. Panelboard: Panelboard shall be circuit breaker type custom constructed to utilize minimum enclosure space with breakers as shown. Circuit breakers shall be bolted on type. The panelboard shall be furnished with phenolic nameplates. The panelboard transformer shall be dry type construction sized as shown on the plans with primary breaker protection.

G. Panel Lights: Furnish and install push-to-test lights to indicate status and alarm conditions locally as shown on drawings. Engraved phenolic nameplates shall specify each light's function. Lights shall be wired as shown on drawings.

H. Push-Buttons and Selector Switches: Push-buttons and selector switches, for non-hazardous indoor dry locations shall be of the oil-tight type and shall be mounted in equipment covers or oil-tight NEMA 1 enclosures, as indicated. These devices shall have individual, extra large nameplates indicating their specific function.

I. Receptacles, Duplex: Receptacles shall be of specification grade and of NEMA configuration and rated 2 pole, 3 wire grounding, 20 amperes, 125 volts. Contact arrangement shall be such that contact is made on two sides of each inserted blade. Bases shall be of ivory phenolic composition. Wire terminals shall be suitable for 10 AWG wire and shall be screw type. Receptacles shall be UL listed. The receptacles shall have corrosion resistant conducting parts of nickel-plated brass and other metal parts of stainless steel. All external and dead front receptacles shall be installed on ground fault interrupter circuits "GFCI".

J. Relays, Control: Two form-C contacts (minimum) shall be provided on each relay. Provide relay energized neon lamp (inside relay case).

K. Relays, Power Fail: The power fail relay shall continuously monitor the three phases for power loss, low voltage, phase loss, phase reversal and have automatic reset. The power fail monitor shall have a drop-out voltage adjustment and a failure indicating LED.
L. Relays, Probe: Probe relays shall be provided for functions as shown on plans, i.e. moisture probes, motor over-temperature, etc. The unit shall be specifically designed for monitoring conductivity type probes and switching type sensors in hazardous areas. The unit shall utilize low current (120 micro amps maximum) and low voltage (12 volts d-c maximum) limiting the power entering the hazardous area to less than 1.5 milli-watts. Unit sensitivity shall allow pick-up on circuit closures of 100 K ohms or less. The probe relay shall be a TESCO 72-144, or equal.

M. Relays, Time Delay: Time delay relays shall be solid state relays with a timer adjustable over the range 1 to 60 seconds unless other ranges are indicated or required. Provide LED relay energized indicator lamp.

N. Service Entrance: The electric service meter compartment shall be arranged approximately as shown to meet the electric utility company and WUSSC requirements. Provide neutral bar for grounding -- 480 volt 3 phase 3 wire service. Provide guard over power company watt hour meter with hinged access cover that has a hasp for utility company padlock. Provide wire and lugs for service entrance as required by utility company. The pull section and utility compartments shall be accessible only by the utility company. A lightning arrestor shall be provided to protect the panel equipment from lightning and utility power surges. Provide a meter base, test perch with test by-pass and other materials, as required by the electric utility which will provide service to the facility, for installation of metering equipment and attachment of service conductors.

O. Terminal and Distribution Blocks: Distribution blocks shall be furnished and installed as required for "fan-out" of control power and other 120V sources within the enclosure. The blocks shall be rated 300V at a minimum of 20 amperes and sized for the conductors served. Programmable Controller Specification

2.2 Control Panel Requirements

A. Manufacturer: The Programmable Controller shall have all the characteristics and features listed herein. All these features shall be readily available as an integral part of the Programmable Controller and shall be standard catalog items for the product. The use of any third party hardware or software add-on products to meet this specification is not acceptable. The L2000 Programmable Controller from Tesco Controls, Incorporated or preapproved equivalent is acceptable.

The Programmable Controller shall be procured from a manufacturer that has at least 10 years experience manufacturing its own Programmable Controllers designed specifically for the water and waste water industry. The Programmable Controller itself and support for the controller shall be available directly from the manufacturer. Programming services shall be available direct from the manufacturer as a normal practice. The manufacturer shall also produce a Supervisory Control and Data Acquisition (SCADA) system that integrates directly with the Programmable Controller, supporting the controller's native communications protocol, to take full advantage of its capabilities.

B. Warranty: The Programmable Controller manufacturer shall provide a 5 year warranty with the unit. These warranties shall be available in writing directly from the manufacturer before bid acceptance. A warranty or service contract from a source other than the Programmable Controller manufacturer is not an acceptable substitute. The warranty shall provide for direct on-site replacement of the entire plug-in Programmable Controller, complete with the original program and configuration. The manufacturer shall provide personnel to perform the warranty service, at no additional cost to the purchaser. The replacement controller
shall be available within 24 hours, installed and running at the station, without requiring that the original unit first be removed and returned to the factory.

C. Telephone Support: The Programmable Controller manufacturer shall provide telephone support for questions related to any aspect of the controller, including general use, application-specific issues, programming, and use of the programming software. This support shall be available directly from the manufacturer at no extra charge with the purchase of a controller.

D. Construction: The Programmable Controller should be constructed using a card cage architecture incorporating a 96 pin 3U DIN VME standard backplane interconnection. The printed circuit cards shall be designed to slide into the card rack and interconnect with the VME backplane. A high density I/O card with a mix of I/O types as well as an I/O card for each individual I/O type shall be available. The system shall operate with a minimum of 2 cards and shall be easily expandable to 20 cards. The Programmable Controller shall be solidly mountable, but shall be capable of being removed easily in the field. Card cages with a capacity of 2 to 20 slots shall be readily available. All field wiring to the I/O cards shall be done at externally mounted terminal blocks with ribbon cable interconnects to the relative I/O card.

E. Operating Conditions: The Programmable Controller shall operate correctly under an ambient temperature range of -40 to +200 degrees F without requiring forced air or other special cooling measures. Coatings on connectors, component leads, and other materials used in the construction of the Programmable Controller shall be substantially resistant to atmospheres containing significant amounts of Hydrogen Sulfide gas and Chlorine gas. Each component shall have passed testing and be certified in writing by the manufacturer to be acceptable for use in water treatment and waste water treatment environments.

F. Other: The Programmable Controller shall have a low-power shut-down mode suitable for use in solar or other sites where power consumption is critical.

1. The Programmable Controller shall be provided with a complete operations and maintenance manual.

2. At minimum, each Programmable Controller shall be subjected by the manufacturer to a 5 day burn-in procedure at 165 degrees F.

G. Card Architecture:

H. Processor Card: The Programmable Controller shall be microcontroller-based, using a microcontroller that, at minimum, supports the following:

1. 25/33 MHz clock rate
2. Flat (non-segmented) memory addressing
3. RISC Communication Co-Processor
4. Serial DMA channels
5. Dual-ported RAM
6. Watchdog timer
7. 4 configurable timers with interrupt capability
8. 6 serial ports with separate baudrate generators
9. Write-protect enable/disable
a. The Programmable Controller shall use a real-time, preemptive, multitasking operating system, contained in Read Only Memory (ROM). The ROM shall also contain all firmware that is not specific to a particular job or application, such as operator interface and communications firmware.

b. Application-specific programming and data shall be contained in battery-backed RAM. The RAM shall be low standby power, CMOS static RAM. The backup battery shall maintain RAM contents when the Programmable Controller is not connected to an external power source. The backup battery shall be a Lithium cell capable of continuously powering the RAM in a standby state for a minimum of 10 years with no loss of data. The Programmable Controller shall be available with a total of at least 1 megabytes of RAM.

c. The RAM shall be divided into two sections - write-protected, and non write-protected. The boundary between these two sections shall be user definable.

d. Critical information, including the application program, control constants (setpoints), and configuration information shall be stored in write-protected RAM. The controlling of write-protected RAM shall be an integral feature of the microcontroller allowing writes to the write-protected memory only after a proper registration sequence. The Programmable Controller shall contain a watchdog timer circuit that will reset the microcontroller within 1 second of detecting a firmware failure. To provide a means of checking data integrity, the Programmable Controller shall compute a CRC-16 value on the contents of write-protected RAM whenever the data is changed and store the CRC value in a reserved location of write-protected RAM. An ongoing self test process shall periodically recompute the CRC and check it against the stored CRC during normal operation.

e. Non write-protected RAM shall be used as a scratch area to hold temporary information and data values that are subject to constant change.

f. A dedicated TELCO style communications port shall be readily available for maintenance port operations using a laptop computer. Up to five additional communication ports shall be available for telemetry operations. A fault relay connector shall be readily available to provide closed contacts in the event of an internal failure or power loss.

I. High Density Input/Output Card: The Programmable Controller shall support the following high density card with the listed characteristics:

Analog input: Senses voltage or current (selectable for 0-5V or 4-20 mA)

- minimum 12-bit resolution
- differential, isolated
- available with at least 6

Analog output: Sources voltage or regulates current (selectable for 0-5V or 4-20 mA)

- minimum 12-bit resolution
- differential, isolated in current mode
- available with at least 2

Digital input: Senses a contact open/closed condition

- 7500 V optically isolated
- LED annunciators for each input on card faceplate
- available with at least 16
Digital output: 10A relay contact
   LED annunciators for each output on card faceplate
   available with at least 8

J. Input/Output Characteristics: The Programmable Controller shall provide built-in digital filtering of analog inputs. The filter constants shall be adjustable from the keyboard and through the communications ports. Each analog input shall have an independent filter constant. The Programmable Controller shall provide a virtually infinitely variable wide range of adjustment from no filtering to extreme filtering. Each analog output shall have the ability to maintain output or zero output when entering standby mode. Each digital output shall be turned off when entering standby mode.

K. Field Wiring Terminal Blocks: The terminal blocks shall support the following listed characteristics:
   - Pull-apart two piece wiring blocks for fast and easy wiring/re-wiring.
   - Separate wiring blocks for each I/O type and each wire point fully labeled.
   - Versatile internal or external analog power source.
   - Digital outputs shall have socketed 10A relays with LED “ON” indicators.
   - Entire terminal block shall snap on/off standard track mount.

   - Onboard passive circuit protection to protect programmable controller.
   - Shall be available with a built-in isolated current loop power supply, powered from the 12V DC main power. The current loop power supply shall be capable of producing at least 24V DC and 161 mA.

   - 3 distinct classes of lightning protection shall be available:
     Standard Class A lightning protection shall consist of
dual MOVs at each AI/AO
individually fused AI/AO power source
fused DI source and common with clamping diodes
onboard spare fuses for all fuse types
Class AA lightning protection shall, in addition to Class A, include
dual gas discharge tube at each AI/AO
Class AAA lightning protection shall offer the most comprehensive protection
full 500 joule 12 stage lightning protection at each AI/AO

L. Power Supply: The Programmable Controller shall be powered by a 12V/5V DC power supply, with an allowed operating range of at least +/- 10%. A 12V battery backup of the 12V DC shall be available such that the 5V DC is also maintained by the 12V battery.

M. Operator Interfaces: The Programmable Controller shall be available with the choice of at least two operator interface units that easily flush-mount in the enclosure door.
   The compact model shall have at least the following attributes:
   60 Brite Lite LED annunciators with adjacent site-specific label descriptions
   8 Brite Lite LED mode annunciators and communication activity annunciators
   8 character Brite Lite alphanumeric display of at least 0.5 inches high
   4 keys to easily traverse a user-friendly menu tree that allows full control of operation
4 user-programmed macro keys with adjacent site specific label descriptions

The full display model shall have at least the following attributes:
360 Brite Lite LED annunciators with adjacent site-specific label descriptions
8 character Brite Lite alphanumeric display of at least 0.5 inches high

4 keys to easily traverse a user-friendly menu tree that allows full control of operation
32 keys for full front panel programming
4 user-programmed macro keys with adjacent site specific label descriptions

The operator interfaces and site specific nomenclature and labels shall be completely covered
with a mylar overlay that is impervious to corrosive atmospheres and wash-down environments.

N. Communications: The Programmable Controller shall have the ability to simultaneously
support at least 4 serial communication ports which includes an Ethernet/IEEE 802.3 and a
DeviceNet industrial network. Any of these serial ports shall be usable for both
communications of telemetry data and control program/configuration upload/download and
support baud rates of 230,400 bps or higher. The ports shall be configurable to support the
following media:

  Full handshake RS-232 (at least 3 ports must be configurable this way)
  RS-485 (at least 3 ports must be configurable this way, selectable for 2/4-wire)
  Direct Modem available with radio interface, supporting Bell 202 standard

O. QuickLoad Software: A fast and easy to use software program shall be available free of
charge to Upload and Download from a laptop computer to the controller all calibration
points, setpoints and native control programming.
1. A complete user's manual shall be provided which describes the use of all
programming software.

P. OPC Communications Server Software: A OPC (OLE for Process Control) communications
server program shall be available to poll the programmable controller and serve real-time
data values to any OPC compliant client, such as spreadsheets, databases and SCADA
systems. This software shall operate on a laptop computer and shall poll the controller
through the maintenance port to gather real-time data of any type and number. Also, the
program shall operate remotely through a POTS dialup phone line to poll for any real-time
data in the controller. The program shall have the ability to operate in a multipoint controller
environment, up to 100 controllers, with full hardware handshaking to the communications
media. The program shall have the ability to display all telemetry message transactions for
the communications port and shall utilize protocol disciplines such as retries, comm. failures
and automatic comm. recovery methods.

Q. Communication points include but not limited to:
1. Submersible pump on and off
2. Submersible pump run time hours, amp draw, KW, and total flow
3. Wet well levels
4. Pumps: lead, lag, auto, manual, start, stop, and standby status
5. Wet well alarms: low, high, pump fail to run, and power failure
6. VFD status
7. Intrusion Alert
8. Engine Generator on-off status, and low fuel level
9. Timer control for odor irrigation and blower in odor control system

2.3 Power Supplies

A. Uninterruptible Power Supply (UPS)
   1. The UPS shall be installed within the control panel and power all process related 120 VAC devices and DC power supplies.
   2. The UPS capacity size shall be as shown in the contract drawings. The battery capacity shall be such that it may provide nameplate power for 10 minutes (min) from a fully charged battery(s).
   3. The UPS shall provide surge protection and filtering: 0.3% IEEE surge let-through, zero clamping response time to meet UL 1449. The inverter shall provide true sine wave output.
   4. When the Utility power voltage is outside of a preset range (approx. 400 < V < 130 VAC) then the UPS shall power the load from storage batteries and a solid state inverter.
   5. The power supply shall be wired into the control panel power circuit per the contract drawings.
   6. The UPS operating ambient temperature range shall be 32 deg F to 122 deg F minimum.
   7. The inverter shall be self-resetting and continuously on-line regardless of the Utility power existence. Configure the UPS to restart automatically upon restart of utility power without operator interaction. The rectifier charger shall recharge and maintain float charge on the batteries automatically.
   8. The UPS shall be of a readily available commercial manufacturer. Provide American Power Conversion Smart UPS, MGE Pulsar Evolution or approved equal.

B. DC Power Supply (PS)
   1. The DC power supply shall utilize a switching power stage, rectifier and voltage regulator. The power supply case shall be DIN rail mountable.
   2. The power supply shall operate on 120V AC and provide DC output voltage and current as shown in the Contract drawings.
   3. The power supply shall be wired and fused per manufacturer instructions and Contract drawings. Power supply output shall include self-resetting overcurrent protection.
   4. The power supply shall provide 2% voltage regulation for a change of 10% load to 100% full load.
   5. The DC power supply shall be IDEC PS5R Series, Phoenix Contact Quint Power, Genesis Automation GDA, or approved equal.

2.4 Miscellaneous Components

A. Circuit Breaker: The disconnecting circuit breaker shall be din rail mounted with finger safe pressure plate terminals. Provide Allen Bradley 1489-CB or approved equal.

B. Fluorescent Light: The fluorescent light shall be an "under cabinet" style with a single bulb and acrylic diffuser. Lamp shall be switched on/off with an integral door activated pin switch.
Fluorescent Light shall be Hoffman A-LF series of length shown on Contract drawings, or approved equal.

C. Circulation Fans: The control panel temperature shall be maintained 10 deg. F below lowest internal device’s temperature rating. The fans shall be 4” (mill), 100 CFM, unless otherwise noted on Contract drawings. The Contractor shall calculate the heat generation of all internal components and determine if the fans submitted will meet the cooling requirements of the internal components. Circulation fans shall be Dayton (Grainger #4C549) with wire guard (or louver with filter as required), Genesis Automation KRYOS GSV1000, or approved equal.

D. Thermostats: The air circulation fans shall be controlled by adjustable thermostat. The thermostat shall be mounted near the top of the panel and easily accessible by a technician. The thermostat shall be capable of control of a heater or cooling fans) by selecting the proper contact logic. The thermostat range shall be adjustable from 30 to 140 deg F. Thermostat shall be Hoffman A-TEMxx, Genesis FGTxxx or dual heat/cool version Genesis Automation ZROll as required for application or approved equal.

E. Wireway: Manufactured from light gray rigid PVC suitable for continuous use at temperatures up to 50 deg C. Wireway shall be 2” height, width as required with 0.5” slot spacing with 11 removable covers. Provide Panduit type "F" or approved equal.

PART 3 EXECUTION

3.1 Workmanship

A. All work in this Section shall conform to the codes and standards specified in Section 160 -Electrical.

B. Ensure that all components fit within the panel, on the backpanel or door, with proper clearances per manufacturer’s instructions.

C. Perform work to remedy non-compliant installations after inspection.

D. The Engineer reserves the right to halt any work that is found to be substandard or being installed by unqualified personnel.

3.2 Installation

A. Equipment Mounting:
   1. Mount all equipment using manufacturers mounting tab holes where possible. Where not possible, construct custom brackets to panel mount or backpanel mount components as shown in the Contract drawings.
   2. Equipment or laptop shelves shall be provided where shown on the Contract drawings. Equipment shown on shelves shall not be placed on the bottom of the panel after field installation.
   3. All nuts, bolts, screws, washers and hinges used in the panel shall be stainless steel. All components shall be mounted using bolts or screw fasteners only which are drilled and tapped into the backpanel. Pop rivets shall not be allowed within panel except for enclosure support arms.

B. Wiring
1. Install all products per 16010 - Electrical, Installation.

2. All field wires and panel wires shall be per section 160123 - Conductors.

3. Panel Wiring: All wiring shall be installed in wireways between terminal blocks, PLC and devices. Reference Contract drawings for Control panel power distribution diagram and control panel elemental diagrams.

4. Field Wiring: Wireways shall be provided for field wiring. Reference Contract drawings for Control panel power distribution diagram and control panel elementary diagrams.

C. Cleaning

1. The Contractor shall clean the inside of the control panel of any dust or debris remaining at the completion of installation and testing. The Contractor shall exercise care when using a vacuum cleaner or compressed air such as not to permanently damage any component within the panel.

3.3 Operating and Maintenance Instructions

A. Provide Operation and Maintenance Instructions.

3.4 Field Assistance

A. Provide manufacturer’s recommendation and as directed by the owner’s Representative - Factory and Field Testing.

PART 4 MEASUREMENT AND PAYMENT

4.1 Compensation

Full compensation for furnishing labor, materials, tools, equipment and incidentals for doing all work involved in Power Distribution and Control Panels as shown on the Plans, as specified in these Technical Specifications and as directed by the Owner’s Representative, shall be included under the Contract Bid items to which this work relates and no additional compensation will be allowed therefor.

END OF SECTION

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