

BASIC AND TECHNICAL SPECIFICATIONS

SECTION 01000
GENERAL REQUIREMENTS

1. Definitions

Whenever the terms herein defined occur in these Specifications or other related documents, they shall have the meanings here given.

- a. "Agency", "Owner", or "District" shall mean the REDEVELOPMENT AGENCY FOR THE COUNTY OF RIVERSIDE, 3403 Tenth Street, Suite 500, Riverside, California 92501, its Executive Director, and any other person or persons designated by the Owner to act on its behalf.
- b. "Manager" shall mean the person designated by the Board of Directors of the REDEVELOPMENT AGENCY FOR THE COUNTY OF RIVERSIDE to have charge, supervision, and administration of said Owner.
- c. "Contractor" shall mean the person, firm, or corporation responsible for the construction of facilities and improvements or any portions thereof to be integrated into Owner's facilities, either on behalf of the Owner or on behalf of a Developer.

Contractor shall at all times be represented on the Work in person or by a duly designated agent or superintendent. Contractor shall hold a valid Contractor's License in accordance with the provisions of Division 3, Chapter 9 of the Business and Professions Code of the State of California, and any amendments thereto.

- d. "Work" shall mean all Work to be performed by Contractor and shall be as specified by these Specifications and the Construction Drawings, Special Requirements, and Specific Directions for any particular project.

The Owner may at any time during Work, by written order, make such changes as found necessary in the character, quality, or quantity of the Work to be furnished.

- e. "Construction Drawings" shall mean those drawings approved by the Owner showing dimensions, details, features, and requirements of the Work. Said Construction Drawings shall be used in conjunction with Special Requirements or Specific Directions and shall be augmented by these Specifications and the Standard Drawings.
- f. "Special Requirements" shall mean those requirements describing Work not specified by Construction Drawings or Specific Directions, clarifying Work as shown by Construction Drawings or as described by Specific Directions, or supplementing or modifying these Specifications. Said requirements may be written or verbal.
- g. "Specific Directions" shall mean those instructions of the Owner supplementing or modifying the Construction Drawings, Special Requirements, and Specifications and shall include all Work not specified by Construction Drawings or Special Requirements. Said instructions may be written or verbal.
- h. "Specifications", also "Construction Specifications", shall mean the requirements contained herein and shall apply to all Work, where applicable, unless specified otherwise, in the Construction Drawings, Special Requirements, or Specific Directions.

Said Specifications shall augment Construction Drawings, Special Requirements, or Specific Directions and shall pertain to all methods and materials of construction.

- i. "Standard Drawings" shall mean all drawings referenced as such and bound with the Specifications. Said Standard Drawings shall be considered an integral part of the Specifications.
- j. "Standard Specifications" shall mean the Standard Specifications for Public Works Construction, latest edition, as published by Building News, Inc, Los Angeles, California. The Standard Specifications shall augment, not supersede, the "Construction Specifications". As used herein, the Standard Specifications shall not apply to measurement, payment, schedule, delays, or extra work.

2. Abbreviations

Whenever used in these Specifications, the following abbreviations shall refer to the agency shown:

a.	AASHTO	American Association of State Highway and Transportation Officials
b.	ACI	American Concrete Institute
c.	AISC	American Institute of Steel Construction
d.	AISI	American Iron and Steel Institute
e.	ANSI	American National Standards Institute
f.	API	American Petroleum Institute
g.	ASTM	American Society for Testing Materials
h.	AWWA	American Water Works Association
i.	AWS	American Welding Society
j.	CRSI	Concrete Reinforcement and Steel Institute
k.	DIPRA	Ductile Iron Pipe Research Institute
l.	EIA	Electronic Industries Association
m.	IEEE	Institute of Electrical and Electronic Engineers
n.	IPCEA	Insulated Power Cable Engineers' Association
o.	NBFU	National Board of Fire Underwriters
p.	NEC	National Electrical Code
q.	NEMA	National Electrical Manufacturing Association
r.	REA	Rural Electrification Administration
s.	SSPC	Steel Structures Painting Council
t.	UL	Underwriters' Laboratories

All references to Specifications of any of the above agencies shall mean the latest editions thereof.

3. Permits, Certificates, Laws, and Ordinances

Unless specified otherwise, Contractor shall at no cost to the Owner obtain all necessary permits, certificates, and licenses from such Federal, State, and local agencies as required to perform the Work. Contractor shall comply with all laws, ordinances, or rules and regulations of said agencies in performance of the Work.

4. **Contractor's Liability**

Contractor shall be responsible, and the Owner shall not be answerable or accountable in any manner, for any loss or damage that may happen to the Work performed by Contractor, subcontractors, or those associated with or working under Contractor, or for any of materials or equipment used or employed in performing the Work, or for injury to any person or persons, including employees, the public, or others, or for damage to property from any cause which might have been prevented by Contractor, subcontractors, or those associated with or working under Contractor. Contractor having control over such Work must properly guard and does indemnify and hold the Owner harmless, and will defend the Owner therefrom at Contractor's own expense, against all injuries or damages to persons and property.

Contractor shall indemnify, defend, and hold the Owner harmless from any and all claims, demands, fines, and penalties imposed or levied by any Federal, State, or local agency associated with or related to the taking (as defined by the United States Fish and Wildlife Service and, or the California Department of Fish and Game) of any protected animal or plant species or habitat by Contractor, subcontractors, or those associated with or working under Contractor.

5. **Rights-of-Way**

a. Permanent Rights-of-Way

For Owner financed Work, Owner will obtain all permanent rights-of-way or permanent easements as required to perform the Work unless specified otherwise. Said rights-of-way will not include rights-of-way for which permits, certificates, and licenses are required from Federal, State, and local agencies, unless specified otherwise.

b. Access or Temporary Rights-of-Way

Contractor shall, at no cost to the Owner, obtain all access or construction rights-of-way of a temporary nature other than specified.

6. **Interferences**

Any and all crossings of public utility facilities such as water mains, sewer lines, gas lines, electrical or control cables and/or conduits, telephone and/or telegraph cables and/or conduits shall be made by Contractor in accordance with requirements and Specifications of appropriate agencies. Contractor shall obtain any necessary permits, licenses, and/or agreements required by said agencies.

Whenever facilities are encountered by Contractor, he shall ascertain the ownership thereof and shall make all necessary arrangements with the owners for the protection, removal, relocation, and/or replacement thereof. Contractor shall give the owners due notice of his requirements and shall give them convenient access and cooperate with them in every way while any work of removal and/or replacement is being performed.

7. **Sanitation**

All parts of the Work shall be maintained in a neat, clean, sanitary condition. Fixed and portable toilets, inaccessible to insects, shall be provided wherever needed for use by employees and their use shall be strictly enforced. All waste and refuse from sanitary facilities or from any source

related to Contractor's operations shall be disposed of in a sanitary manner satisfactory to the Owner and in accordance with laws and regulations pertaining thereto. Contractor shall rigorously prohibit and prevent committing of nuisance within the Work area or upon the Owner's right-of-way or adjacent private property. Contractor shall furnish all facilities and means for proper sanitation for the Work and shall indemnify, protect, and save the Owner harmless from any liability resulting from improper or insufficient sanitation.

8. Accident Prevention and First Aid

Contractor shall provide a safe working environment for all persons working on or affected by the Work. Contractor shall take precautions for the protection of persons and property at all times during the course of the Work. Contractor shall exercise and observe the safety provisions of applicable laws and building and construction codes. Contractor shall maintain in good and safe operating condition all equipment and facilities required for proper execution and inspection of the Work.

Contractor shall guard machinery, equipment, and hazards in accordance with safety provisions of the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America, the Construction Safety Orders and Trench Construction Safety Orders as issued by the Division of Industrial Safety of the Department of Industrial relations of the State of California, and Chapter 8 ("Traffic Control and Protection of Workmen") of the Manual of Instruction for the Maintenance Department of the State of California Department of Transportation, to the extent that such provisions are not inconsistent with applicable laws or regulations.

All warning signs, lights, barricades, and other measures designed to protect the traveling public shall be erected and maintained in good order by Contractor in accordance with applicable provisions of Chapter 21 ("Maintenance Signs, Barricades, and Traffic Control") of the Manual of Instruction for the Maintenance Department of the State of California Department of Transportation and of the applicable ordinances of the public agency having jurisdiction over the maintenance and policing of highways, thoroughfares, and streets. Special regard shall be given to the rights and convenience of the traveling public and the property owners and residents in the area of Work. Cross-over boards or steel plates approved by the Owner shall be placed and other precautions taken whenever necessary to provide for at least one-way traffic along all traveled streets and to provide access to driveways and residences, unless specified otherwise.

9. First Aid Facilities

Contractor shall keep first aid facilities and supplies on the jobsite. Contractor shall provide instruction in first aid as required by State regulations. Contractor shall provide emergency first aid treatment and supplies for his employees sufficient to comply with all applicable laws.

10. Materials

Contractor shall furnish only approved materials as listed in the Owner's approved material list (if applicable). All materials to be furnished by Contractor shall be new and of the best quality for their intended use. All like materials shall be of one manufacture for any particular project.

Contractor shall submit 3 copies of all material lists to the Owner for approval thereof. Said material lists shall include manufacturer's name, designation, description, and related information of all materials to be furnished and installed or otherwise used by Contractor in the performance

of the Work. Said material lists shall be submitted at or prior to project preconstruction meeting and said lists shall be approved by the Owner prior to beginning construction.

11. Construction

Contractor alone shall be responsible for the safety, efficiency, and adequacy of his plant, equipment, appliances, and methods and for any damage which may result from their failure or their improper construction, maintenance, or operation.

Contractor shall be responsible for examining all Construction Drawings, Specifications, Standard Drawings, Work site, delivery routes, and local conditions which may affect the Work.

Before proceeding with the Work, Contractor shall furnish the Owner any information required of him by the Construction Drawings, Specifications, Standard Drawings, Special Requirements, and Directions of the Owner.

Contractor shall keep at jobsite a complete set of Construction Drawings, Specifications, Standard Drawings, permits, certificates and licenses for the Work, and all other data required by the Owner. Contractor shall be responsible for checking all dimensions and quantities on said drawings or schedules and shall notify the Owner of any errors and omissions found.

Until acceptance of the Work by the Owner, Contractor shall bear the risk of injury or damage to any part of the Work by action of the elements or from any other cause and Contractor shall rebuild, repair, restore, and make good any injuries or damages to the Work except as limited in the Contract Appendix.

Contractor shall cooperate with other contractors who are working in the project area as the Owner may specify and he shall comply with all orders of the Owner. Contractor shall employ only competent and skillful persons to perform the Work. Said persons shall be qualified or certified to perform the Work in accordance with requirements of said person's trade.

Contractor shall submit to the Owner for approval a construction schedule covering all Work based on normal work periods. Contractor shall not deviate from approved schedule without prior permission from the Owner. Whenever Contractor arranges to work at night or at any time other than normal work periods or to vary the period during which Work is to be carried on each day, he shall obtain special permission from the Owner to do so and he shall keep the Owner properly informed of his activities. Construction schedule shall show the order in which Contractor proposes to carry out Work, dates of anticipated commencement and completion of Work and salient components thereof, and estimated percentage of Work to be completed at any time during the construction period.

12. Records of Construction

Contractor shall maintain at least one complete set of Construction Drawings on the jobsite during the course of construction upon which he shall note any changes in the Work as they occur. Contractor shall maintain said Drawings so that the Owner may at any time during the course of construction ascertain the changes that have occurred. Said Construction Drawings shall be the basis of the two sets of record drawings that Contractor shall provide the Owner upon completion of the Work.

13. Inspection

All materials and equipment furnished and all Work performed shall be subject to rigid inspection by the Owner. Contractor may be required to remove and replace under proper inspection any Work performed in the absence of prescribed inspection, with the entire cost being borne by Contractor irrespective of whether such Work is found to be defective. Work covered up without authority of the Owner shall, upon order of the Owner, be uncovered to the extent required to permit inspection, repair, or replacement and thereafter be recovered, and Contractor shall bear entire cost.

14. Examination of Work

Contractor shall furnish the Owner every reasonable facility for ascertaining whether Work is being accomplished in accordance with the requirements and intention of the Construction Drawings, Specifications, Standard Drawings, Special Requirements, and Directions of the Owner.

15. Right to Occupy Work

The Owner may wish to occupy or place in service portions of the Work before its final completion and shall be at liberty to do so. Such occupancy or placing in service of any portion of the Work shall not relieve Contractor of his responsibility of protection and care of all Work until final completion and acceptance provided, however, that expense directly attributable to operation and placing portions of Work in service shall not be chargeable to Contractor.

16. Maintenance and Guarantee

Contractor shall guarantee that all Work performed by him meets all requirements specified as to character, quality, and quantity of materials and workmanship. Contractor shall replace all materials and pay all installation costs made necessary by defects in materials or workmanship supplied by him that become evident within one year after acceptance of the facilities or the date of final payment, whichever occurs later.

Contractor shall replace all defective materials promptly upon receipt of written notice from the Owner. If Contractor fails to replace all defective materials promptly, the Owner may secure the service of others to perform the Work and Contractor shall be liable to the Owner for any costs including removal and replacement thereof.

17. Construction Power

Contractor shall provide all necessary power required for his operations, and shall provide and maintain in good order such modern power equipment and installation as shall be adequate, in the opinion of the Owner, to perform the required Work in a safe and satisfactory manner.

18. Construction Water

Unless specified otherwise, the Owner will provide construction water to Contractor from its existing system at established rates. Contractor shall furnish and install all necessary piping and appurtenances necessary to convey water from the Owner's metered service connection to place of use.

19. **Welding**

Welding shall be done by the electric arc method using a process which excludes the atmosphere from the molten metal, except where otherwise approved by the Owner. Welding electrodes used for manual welding shall be an approved type. Except as modified herein, welding process qualification and operator qualification shall comply with the applicable requirements of the "Code for Arc and Gas Welding in Building Construction" of the AWS.

Each weld shall be uniform in width and size throughout its entire length. Each layer shall be smooth, free from slag, cracks, pinholes, and undercut and shall be completely fused to adjacent weld beads and base metal. Cover pass shall be completely free of course ripples, irregular surfaces, non-uniform bead pattern, high crown, deep ridges, or valleys between beads, and shall blend smoothly and gradually into surface of base metal. Butt welds shall be slightly convex, of uniform height, and shall have full penetration. Fillet welds shall be of size indicated, with full throat, and with each leg of equal length. Repair, chipping, or grinding of welds shall not gouge, groove, or reduce base metal thickness.

20. **Environmental Factors**

Contractor shall take all reasonable precautions to protect the environment.

a. Air Pollution

Contractor shall use only machinery and equipment which is equipped with suitable air pollution control devices so that undue quantities of pollutants are not added to the atmosphere in the vicinity of the Work site. Contractor's equipment shall meet all Federal, State, and local requirements for air quality emissions and Contractor shall comply with all applicable Federal, State, and local air pollution control regulations.

Contractor shall also take all necessary precautions to control dust created by construction operations. Contractor shall be especially diligent in implementing his dust control program and he shall be prepared to respond immediately and positively to any instructions for corrective action given by the Owner. Contractor shall use dust palliatives if necessary to satisfactorily control dust; however, Contractor shall secure the Owner's approval for use of dust palliatives other than water.

b. Explosives

Contractor shall handle, transport, store, and use explosives in accordance with applicable Federal, State, and local laws and regulations. Contractor shall be responsible for and make good any damage caused by his use of explosives.

c. Fires

Contractor shall exercise all precautions necessary to prevent unauthorized fires within or adjacent to the limits of the Work. Contractor shall be responsible for all damage resulting from fire due directly or indirectly to his or his employees' activities or the activities of his subcontractors or their employees.

d. Drainage and Flooding

Contractor shall manage excavation and spoil banks such that existing drainage conditions are not impaired. Contractor shall provide drainage in all cases where the existing drainage conditions are being unavoidably altered or disturbed by his operations. Temporary diversions, ditches, checks, swales, or other drainage structures or features necessary to ensure proper drainage and flood control shall be provided by Contractor at no extra cost to the Owner.

e. Historical and Archaeological Sites

If Contractor should encounter any evidence of historical or archaeological significance, he shall immediately cease construction, notify the Owner, and refrain from any activity until the Owner orders Work to resume. The Owner will assume full responsibility for any delays caused by historical or archaeological investigations.

f. Noise Pollution

Contractor shall equip all machinery and equipment used for construction with noise control devices such as mufflers for internal combustion engines or other suitable noise suppressors. Noise produced by construction operations shall be kept to a minimum and shall be consistent with reasonable human health requirements considering time of day and location of Work site. Contractor shall comply with all applicable Federal, State, and local noise pollution control regulations.

Unless specified otherwise, noise levels in connection with the Work shall not exceed 75 dB(A) at a distance of one hundred (100) feet for relatively continuous exposure and they shall not exceed 90 dB(A) at that same distance for relatively infrequent intermittent exposure. Contractor shall be prepared to respond immediately and positively to any instructions for corrective action given by the Owner particularly with respect to complaints from the public.

g. Public Relations

Contractor shall give due consideration to the comfort and convenience of the public and he shall instruct his employees to be polite and respectful in their dealings with the public at the Work site and in traveling to and from the Work site.

h. Traffic

Contractor shall adequately protect the public using any roads which are involved in Contractor's operations and he shall maintain safe traffic flow in the vicinity of the Work. Contractor shall use signs, barricades, delineators, flashers, and flagmen, all in strict compliance with Federal, State, and local rules and regulations regarding traffic control. Public roadways shall not be barricaded or blockaded except in accordance with requirements of public agencies having jurisdiction over same. Contractor shall provide access to all walkways, sidewalks, driveways, and streets at all times. If requested by the Owner, Contractor shall furnish a traffic control program for the Work.

i. Vegetation and Wildlife

Contractor shall not destroy or disturb any vegetation or habitat unless absolutely necessary for the performance of the Work. Contractor shall take all steps necessary to ensure that his employees do not destroy or disturb any vegetation or wildlife in the prosecution of the Work or incidental thereto, including travel to and from the Work site.

j. Water Pollution

Contractor shall discard materials which might adversely affect ground or surface water at approved dump sites only. Chemicals and other water pollutants shall not be discharged into natural watercourses or on land tributary to said watercourses. Contractor shall comply with all applicable Federal, State, and local water pollution control regulations.

k. Cleanup

Contractor shall keep the premises occupied by him in a neat, clean condition free from unsightly accumulation of rubbish. Contractor shall maintain all Work areas within or without the project limits free from dust which would cause a hazard to the Work, operations of other contractors, or other persons or property. Upon completion of the Work, Contractor shall at his own expense satisfactorily dispose of or remove from the vicinity of the Work all plants, building, rubbish, unused materials, concrete forms, and other equipment and materials belonging to him or used under his direction during construction and, if he fails to do so, the same may be removed and disposed of by the Owner at Contractor's expense.

SECTION 01026
SCHEDULE OF VALUES

PART 1 – GENERAL

1.01 Requirements

- A. Within thirty (30) days of the Notice to Proceed or within forty five (45) days of the Notice of Award, the Contractor shall submit a Schedule of Values for the Owner's approval. The Schedule of Values is a detailed itemized breakdown of all lump sum bid items.
- B. The Schedule of Values shall be used as a basis for determining progress payments on a lump sum contract or any designated lump sum bid item. The Schedule of Values shall be a schedule of cost loaded construction activities equal, in total, to the lump sum bid and shall be in such form and sufficient detail to correctly represent a reasonable apportionment of the lump sum. Prior to submitting a monthly payment request, the Contractor shall have submitted a detailed Schedule of Values and obtained approval from the Owner.
- C. Each lump sum bid item on the Bid Schedule(s), as set forth in the Contractor's Bid Proposal must be broken down separately. The breakdown of each lump sum bid item must cover the cost of construction required by the Contract Drawings and Specifications for that item. The sum of the values for the construction activities, within a bid item, must equal the total bid amount for that item. The breakdown shall include subcontract amounts, which shall not deviate from the amounts submitted in the Bid Proposal. The Contractor shall provide certification from the Subcontractors certifying the subcontract amounts.
- D. Each activity in the Schedule of Values shall delineate one construction activity. For example, the placement of concrete between construction joints, the construction of an electrical duct bank, or pipeline between points A & B. The costing for each activity should include all costs for the labor and materials or equipment required to complete the activity. For example, concrete construction activities should include all costs for the forming, placing of reinforcement, placing concrete, and curing. The cost for pipeline construction activities should include materials, equipment, and installation, including pipeline supports or thrust blocks. The excavation and backfill for a pipeline or structure may be separate activities. The Bid Proposal breakdown shall include the itemized costs for the plant startup and testing to be performed before the final project acceptance is made. No non-construction activity shall be cost loaded.
- E. Where Contract Documents require a CPM Construction Schedule, the Contractor shall use cost loaded construction activities from the Construction Schedule as a Schedule of Values. Each construction activity shall be encoded to its bid item and a sort provided for each bid item totaling the cost loaded amount. The total of the cost loaded amounts for each bid item shall equal the amount bid for that item.

- F. The total of the Schedule of Values shall equal the current Contract value at all times. At any time during the progress of the Contract Work, the Owner reserves the right to review the cost loading of the Schedule of Values and direct necessary revisions. When requested by the Owner, the Contractor shall provide all information necessary to substantiate the cost loading.

END OF SECTION

SECTION 01300
CONTRACTOR SUBMITTALS
TECHNICAL SPECIFICATIONS

PART 1 - GENERAL

1.01 Description

This Section covers requirements for submittals and forms a part of all other Sections in which submittals are specified or required.

Submittal Requirements Included in this Section

- A. Contractor's Construction Schedule
- B. Shop Drawings
- C. Material Samples
- D. Operation and Maintenance Manuals
- E. Requests for Substitutions or Equals
- F. Record Drawings

1.02 CPM Progress Schedule

Contractor shall submit to Owner a CPM progress schedule to demonstrate the Contractor is sequencing work activities in accordance with the Contract Documents constraints and to assist the Owner in planning the Owner's inspection and operation activities.

- A. Within thirty (30) days of Notice to Proceed (or within forty five (45) days of Notice of Award), Contractor shall submit a Critical Path Method (CPM) analysis for construction progress control, prepared on 11 inch x 17 inch charts. All construction activities and procurement shall be indicated in a time scaled format and a calendar shall be shown on all sheets along the entire sheet length. Each activity arrow or node shall be plotted so that the beginning and ending dates of said activity can be determined graphically by comparison with the calendar scale. All activities shall be shown using the symbols that clearly distinguish between critical path activities, non-critical activities, and free float for each non-critical activity. All non-critical path activities shall show estimated performance time and free float time in scaled form.
- B. The duration estimate indicated for each activity shall be computed in working days and shall be shown on the construction schedule in calendar days. It shall represent the single best estimate considering the scope of the work and resources planned for the activity. Except for certain non-labor activities, such as curing concrete or delivering materials, activity duration shall not exceed ten (10) working days (fourteen (14) calendar days), nor be less than one (1) working day unless otherwise accepted by Owner.
- C. Contractor shall revise and resubmit the CPM progress schedule monthly, flagging all slippages and missed mile posts. Contractor shall attach a narrative description of proposed corrective actions to the resubmitted CPM progress schedule, including the following minimum information for each activity and critical path item:
 - 1. Date of initial shop drawing submittal, as applicable.

2. Engineers time for review of shop drawings.
3. Ordering dates for long lead time items.
4. Dates for materials onsite.
5. Early start work dates.
6. Early finish work dates.
7. Late start work dates.
8. Late finish work dates.
9. Date of initial submittal of operation and maintenance manuals.
10. Date of final submittal of operation and maintenance manuals.
11. Testing and cleanup.
12. Final completion.

Contractor shall modify any portions of the construction schedule that become infeasible due to activities behind schedule or for any other valid reason. Any activity that cannot be completed by its original latest completion date shall be deemed to be behind schedule.

- D. The CPM progress schedule must be submitted to the Owner before the monthly progress payment is made. Scheduling and completion of the project in a timely manner and per Contract completion time, is solely the Contractor's responsibility. The CPM schedules submitted to the Owner shall not modify or revise any Contract provisions presented in the Contract Documents.

1.03 Shop Drawing Submittal

- A. Unless otherwise specified in the Contract Documents, Contractor shall furnish for all equipment and materials to be furnished and installed for the project at least six (6) hard copies and one (1) electronic PDF copy of each shop drawing for Owner's review and approval. Three (3) copies will be retained for Owner's use, and three (3) copies will be returned to Contractor.

~~The term "Shop Drawings" as used herein shall be understood to include all data covering all equipment, equipment components, fabricated materials, and furnished materials.~~

Data shall include, but shall not be limited to, design calculations, equipment drawings, fabrication and installation drawings, erection drawings, mix designs, operating instructions, catalog sheets, data sheets, lists, graphs, and similar items. Data shall demonstrate compliance with the Contract Documents.

Contractor shall submit shop drawings in a timely manner. Contractor shall allow sufficient time for Owner's review and approval of shop drawings. Contractor shall be responsible for any project delays resulting from late submittal of initial shop drawings or resubmittal of corrected or revised shop drawings.

- B. Method of Submittal

Contractor shall deliver shop drawings submittals by means of dated, signed, and sequence numbered transmittals on Contractor's letterhead. Contractor shall clearly describe the submittal contents, identifying whether initial or subsequent submittals and

stating the drawing numbers and specification sections, articles, and paragraphs to which the shop drawings pertain. All data sheets, catalog cuts, or drawings showing more than the particular item under consideration shall be clearly marked to delete all but the applicable information. All data sheets, catalog cuts, or drawings shall be clearly marked to delineate all proposed material and/or equipment options and accessories.

C. Deviations or Exceptions from Contract Documents

Where proposed equipment or materials, equipment components, equipment functions, or equipment operations deviate from the specifications and whenever exceptions to the specifications are taken, it shall be clearly noted on the shop drawing submittals. Deviations shall include references to the specific sections, parts, and paragraphs or drawing numbers and notes for which the deviations or exceptions are made.

D. Contractor's Review

All shop drawing submittals shall be carefully reviewed by Contractor prior to submission to Owner. Contractor shall indicate by a signed and dated stamp on the submittal that Contractor has checked the shop drawings as being correct and in strict conformance with the Contract Documents. Shop drawings not so reviewed by Contractor may be returned without action taken by Owner, and any delays caused thereby shall be the responsibility of the Contractor.

E. Owner's Review

1. Owner's review of the shop drawings submitted by Contractor will cover only general conformity to the Contract Documents. The review of shop drawings shall not relieve Contractor of full responsibility for any deviation from the requirements of the Contract Documents. As specified above, deviations or exceptions to the Contract Documents shall be clearly indicated on the shop drawings. Contractor shall be responsible for any errors or omissions in the shop drawings or for the accuracy of dimensions, quantities, and the design of adequate connections and details.
2. Unless specified elsewhere, Owner will return three (3) sets of shop drawing submittals to Contractor with his comments noted thereon, within thirty (30) working days following their receipt by Owner. It is expected that Contractor shall prepare his submittals in such a manner that he is able to obtain a complete and acceptable submittal by the second submission. Owner reserves the right to deduct monies from the amounts due to Contractor to cover the cost of the Owner's review beyond the second submission.

F. Corrections and Resubmittals

Contractor shall make all required corrections and shall resubmit the required number of corrected shop drawings until found in general conformance with the Contract Documents and design concept of the project. No work which requires shop drawing submittals shall be purchased or commenced until the pertinent shop drawings have been submitted, reviewed, and approved.

1.04 Material Samples Submitted

A. General

Whenever in the Contract Documents material samples are required, Contractor shall submit to Owner not less than two (2) samples of each such item for review and approval, all at no additional cost to Owner. Upon receiving approval by Owner, one (1) set of the samples will be stamped and dated by Owner and returned to Contractor, and one (1) set of samples shall remain at the job site until completion of the work.

B. Delivery

Samples, as required herein, shall be submitted for approval at least thirty (30) days prior to ordering such material for delivery to the jobsite.

C. Identification

Contractor shall label or tag each sample, or set of samples, identifying the manufacturer's name and address, brand name, catalog number, project title, and intended use.

D. Colors, Patterns, and Textures

For items required to be of selected colors, patterns, textures, or other finish, Contractor shall submit sufficient samples to show the range of shades, values, patterns, textures, or other features corresponding to the instructions and requirements specified.

1.05 Operation and Maintenance Manuals

- A. Contractor shall provide to Owner four (4) hard copy sets and one (1) electronic PDF set of detailed operation and maintenance (O&M) manuals for all mechanical and electrical equipment furnished. Each set shall consist of one (1) or more volumes, each volume shall be bound in a standard size, 3-ring, loose leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches. Binder(s) shall be provided with the following identification inscribed on the cover(s): "Owner's name, project name, Equipment Operation and Maintenance Manual, Volume No." Each volume shall have a table of contents which indicates all equipment in the O&M manual and tabbed divider sheets placed before each section. The O&M manuals shall include (but not be limited to) the following information:

Installation and Operation

1. Installation Instruction
2. Design Capabilities
3. Operating Parameters and Recommended Ranges
4. Specific Equipment Installed, Model No., Serial No., etc.
5. General Literature
6. Operating Instructions
7. Special Problems or Precautions and Emergency Procedures
8. Safety Provisions and Precautions

Maintenance

1. Assembly, Disassembly, and Reassembly
 2. Parts List, Including Drawings (Blowup Drawings Preferred)
 3. Lubrication Type and Schedule
 4. Preventative Maintenance Schedule
 5. Recommended Replacement Parts Inventory
 6. Details of Calibration and Adjustment
 7. Wiring Diagrams (as Installed)
 8. Completed Maintenance Card (Copy of Form Attached)
 9. Equipment Warranties
 10. Name, Address, and Phone Number of Local Parts Distributor and Service Center.
- B. All O&M manuals shall be submitted to Owner in final form not later than thirty (30) days before startup; all deficiencies contained therein shall be corrected by Contractor within thirty (30) days from the date of written notification by Owner.

1.06 Requests for Substitutions

- A. Any reference in the Contract Documents to any item of equipment or material, by manufacturer's name, make, or other proprietary identification is intended to establish the type, function, and quality required. If the manufacturer's name is followed by the words "or equal" or "or approved equal", indicating that a substitution is permitted, such items of equipment or materials manufactured by others may be substituted provided sufficient information is submitted by the Contractor to allow the Owner to determine that such items of equipment or materials are equivalent to those named in the Contract Documents, subject to the following requirements:
1. Contractor shall demonstrate equality as to type, function, and quality of each substitute item of equipment or material. Owner shall be the sole judge as to equality; Owner's decision shall be final.
 2. Contractor shall, within 30 days after Notice to Proceed or within 45 days after award of contract, make written application to Owner to furnish or use a substitute item of equipment or material.
 3. Contractor shall submit a list of five (5) installations utilizing the substitute item of equipment or material, including location, contact information (name and phone numbers), and dates of initial operation. The reference provided may be used in part as a basis for establishing the ability of a manufacturer to meet the performance requirements of the specification.
 4. Contractor shall submit documentation that the substitute item has been in use or operation for a minimum of five years (unless noted otherwise). Documentation shall include location and references telephone numbers that are familiar with the item.

5. Contractor shall provide Owner with all requested data in order to evaluate proposed substitution.
6. Acceptance by the Owner of a substitute item shall not relieve Contractor of the responsibility for full compliance with the Contract Documents and for adequacy of the substitute item. Contractor shall be responsible for any changes and costs which may be required for substitutions.
7. Owner shall be allowed a reasonable time in which to evaluate each proposed substitute. Owner will record the period of time required to evaluate substitutions; Contractor shall reimburse Owner for charges whether or not the proposed substitute is accepted.

1.07 Record Drawing Submittal

- A. Contractor shall keep and maintain at the jobsite one (1) set of record drawings. Contractor shall mark on drawings all changes in project conditions, locations, configurations, and any deviations which may vary from the details represented on the original Contract Drawings, including, but not limited to, buried or concealed construction and utility features which are revealed during the course of construction. Contractor shall record the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Contract Drawings.

Said record drawings shall be supplemented by detailed sketches as necessary to indicate the work actually constructed. These master record drawings of Contractor's representation of as-built conditions, including all revisions made necessary by addenda, change orders, and the like, shall be maintained up-to-date during the progress of the work. Record drawings shall be accessible to Owner at all times during the construction period and shall be delivered to Owner upon completion of the work.

- B. Payments pursuant to partial payment will not be made if the record drawings are not kept current, and if the record drawings, showing all variations between the work as actually constructed and as originally shown on the Contract Drawings or other Contract Documents, have not been inspected by Owner.
- C. Final payment will not be acted upon until Contractor has prepared and delivered complete, current record drawings to Owner. Said record drawings which must reflect all completed work, may be in the form of a set of prints with carefully plotted information overlaid in colored pencil.

EQUIPMENT MAINTENANCE DATA SHEET

PREVENTIVE MAINTENANCE PROGRAM		EQUIPMENT RECORD NUMBER		
EQUIPMENT DESCRIPTION		ELECTRICAL OR MECHANICAL DATA		
Name:		Nameplate Horsepower:		
Serial No.:		Model:		
Vendor:		Catalog Number (polyphase motors):		
Vendor Address:		Type:		
		Manufacturer:		
Vendor Rep:		Voltage:	Measured Current:	Nameplate Current:
Phone:		Phase:	Overload Relay Setting:	rpm:
MAINTENANCE AND LUBRICATION WORK TO BE DONE				Frequency*
SPARE PARTS LIST		FUSES/LAMPS/SEALS		
Quantity	Part & Part Number	Qty	Size	Type & Ordering Description
WARRANTY AND OPERATING REQUIREMENTS AND REFERENCE				

*D - Daily; W - Weekly; B - Biweekly; M - Monthly; Q - Quarterly; S - Semiannually; A - Annually

**SAMPLE
EQUIPMENT MAINTENANCE DATA SHEET**

PREVENTATIVE MAINTENANCE PROGRAM		EQUIPMENT RECORD NUMBER		
EQUIPMENT DESCRIPTION		ELECTRICAL OR MECHANICAL DATA		
Name: Influent Pump No. 1 Tag No.: P01-1		Nameplate Horsepower: 15 HP		
Serial No.: 123456ABC		Model: 140T Frame Serial No. 987654ZY Class F Insulation w/ Space Heater		
Vendor: ABC Pump Co.		Catalog Number (polyphase motors): M36999b		
Vendor Address: 1234 Richter Avenue Irvine, CA 92604		Type: Vertical Turbine Pump, Model VTR14 with 3 stages, impeller 147, and 12 1/2" trim.		
		Manufacturer: DEF Motors, Inc.		
Vendor Rep: XYZ Equipment, Inc.		Voltage: 460	Measured Current: 18 amps	Nameplate Current: 20 amps
Phone: 949-752-0505		Phase: 3	Overload Relay Setting: 25 amps	rpm: 1,800
MAINTENANCE AND LUBRICATION WORK TO BE DONE				Frequency*
1. Operate valves and check such things as a) bearing temperature, b) changes in running sound, c) suction and discharge gage readings, d) pump discharge rate, and e) general condition of the drive equipment.				D
2. Check packing.				D
3. Check pumping unit for any dust, dirt or debris.				W
4. Lubricate bearing frame and motor bearings (consult manufacturer's instructions for type of grease or oil).				Q
5. Disassemble and change or repair the following: a) impeller, b) shafts, c) shaft sleeve, d) rotary seals, and e) sleeve bearings.				A
SPARE PARTS LIST		FUSES/LAMPS/SEALS		
Quantity	Part & Part Number	Qty	Size	Type & Ordering Description
WARRANTY AND OPERATING REQUIREMENTS AND REFERENCE				
For manufacturer's instructions regarding installation, operation, maintenance and troubleshooting of this equipment, see Volume ____, Section ____.				

*D - Daily; W - Weekly; B - Biweekly; M - Monthly; Q - Quarterly; S - Semiannually; A - Annually

SECTION 02300
BASIC EARTHWORK SPECIFICATIONS

PART 1 - GENERAL

1.01 Scope

Contractor shall furnish all labor, equipment, and material and perform all operations necessary for earthwork construction including clearing, excavating, filling, backfilling, compacting, and grading specified or reasonably required. All debris or material unsuitable for construction shall be removed from site.

Adequate drainage shall be provided at all times and accumulation of water in excavated areas shall be prevented. All work shall be protected by pumping, ditching, and other measures required for the removal or exclusion of water. Any work damaged by the effects of rain runoff or other weather conditions during any phase of construction shall be reconstructed to conform to the specified requirements. Contractor shall not pass equipment over or alongside facilities that are not protected by ample fill material, properly compacted.

Unless otherwise specified or herein modified, all earthwork shall conform to Section 300 of the Standard Specifications for Public Works Construction, published by Building News, Inc., Los Angeles, California, latest edition, hereinafter "Standard Specifications". References in the Standard Specifications to Measurement and Payment shall not apply.

1.02 Protection of Existing Work

Before beginning any cutting or demolition work for removals, Contractor shall carefully survey the existing work and examine the drawings and Specifications to determine the extent of the work. Contractor shall take all necessary precautions to insure against damage to existing work to remain in place or to be reused and any damage to such work shall be repaired or replaced as approved by Owner at no additional cost to Owner. Contractor shall carefully coordinate the work of this section with all other work and construct and maintain shoring, bracing, and supports as required. Contractor shall insure that structural elements are not overloaded and be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under any part of this Contract.

1.03 Grade Control

Initial bench marks, lines, and grades will be furnished by Owner. Subsequent control stakes as may be required shall be placed and maintained by Contractor. Bench marks, monuments, and other reference points, if unnecessarily disturbed or destroyed by Contractor, will be restored by Owner at Contractor's expense.

1.04 Clearing and Grubbing

Except as otherwise specified, indicated areas should be cleaned and grubbed conforming to Section 300-1 of the Standard Specifications. All removed materials shall be disposed off-site in a location approved by Owner. Bituminous pavement to be removed shall be saw cut to clean, straight lines.

1.05 Field Compaction Tests

Where reference is made to relative compaction, it shall be deemed to mean ASTM D1557, latest, using ten-pound hammer at 18-inch drop.

Cost of all compaction tests having relative compaction less than specified shall be borne by Contractor. Cost of all compaction tests having relative compaction greater than specified will be borne by Owner. Owner will select soil testing engineer.

1.06 Materials to be Excavated

Materials to be excavated shall be non-classified and shall include all materials encountered in excavating and grading operations hereunder. Materials shall be excavated to the depth and extent specified.

1.07 Excavation

Contractor shall excavate to the elevations and dimensions indicated, plus ample space for construction operations and inspection of facilities. All facilities to be constructed shall bear on undisturbed natural ground or material compacted to the relative compaction specified which shall not be less than 90% relative compaction. If so ordered in writing by Owner, Contractor shall perform additional excavation beyond limits originally specified. Concrete shall not be placed in any excavation which has not been approved by Owner. Care shall be taken not to disturb the excavation prepared for concrete and excess material shall not be removed to make grade until just before concrete is to be placed. This work shall conform to Sections 300-2 and 300-3 of the Standard Specifications unless otherwise specified.

1.08 Fill and Backfill

Fill and backfill shall not be placed until all work to be concealed has been inspected and approved by Owner. No fill or backfill material shall be deposited against concrete structures until the concrete has developed its design strength unless authorized by Owner.

Fill and backfill around structures shall be placed in uniform horizontal layers not exceeding 12 inches in loose thickness before compaction and shall be brought up uniformly on all sides of the structure. Regardless of the specified depth of the layers of material to be compacted, Contractor shall place the material at depths required to obtain the specified relative compaction. Each layer of material shall be moistened as required and thoroughly tamped, rolled, or otherwise compacted to the relative compaction specified.

Fill and backfill shall be made with clean, unclassified material excavated from site as approved by Owner. Unless permitted otherwise, said material shall consist of loose earth or sand free from stones, clods, or other deleterious materials larger than 8 inches in greatest dimension.

Whenever permitted by Owner, rock may be placed in certain fills. Rock fragments or boulders up to 24 inches in greatest dimension may be utilized provided that the specified degree of compaction is obtained in the fill material surrounding the rock. The rock fragments or boulders shall be placed in rows on the fill surface so that they are not in contact with one another and fill material shall be placed between and over the rows of rock fragments or boulders and compacted

with a sheeps foot or other suitable rollers. Ample water and compactive effort shall be applied so that the resulting fill is free of uncompacted material surrounding the rock. The rows of rock fragments or boulders shall be as specified with regard to spacing and location within any fill; however, subsequent rows shall be staggered so that one row does not lie directly over another row.

1.09 Finish Grading

Upon completion of construction, Contractor shall bring to finish grade all portions of site affected by contract work. Grading shall be to the finish grade elevations specified. Contractor shall dispose of excess material as directed by Owner.

**SECTION 02825
ORNAMENTAL STEEL FENCING AND GATES**

PART 1 - GENERAL

1.01 General

Contractor shall furnish and install ornamental steel fencing system, including fence panels, posts, gates, and accessories, as shown on the Drawings and as specified herein.

1.02 Related Work Specified Elsewhere

Section 03300 – Cast-in-Place Concrete: Concrete footings for support of fence and gate posts.

1.03 Applicable Specifications and Standards

The following documents of issue in effect on the date of bid form a part of this specification to the extent specified herein:

A. American Society for Testing and Materials (ASTM) Publications:

1. ASTM A36 – Carbon Structural Steel.
2. ASTM A121 – Zinc-Coated (Galvanized) Steel Barbed Wire.
3. ASTM A123 – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
5. ASTM A513 – Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
6. ASTM A653 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
7. ASTM A787 – Electric-Resistance-Welded Metallic-Coated Carbon Steel Mechanical Tubing.
8. ASTM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
9. ASTM D822 – Tests on Paint and Related Coatings Using Filtered Open-Flame Carbon-Arc Exposure Apparatus.
10. ASTM D1794 – Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
11. ASTM D3363 – Test Method for Film Hardness by Pencil Test.

1.04 Contractor Submittals

- A. All submittals shall be in accordance with Technical Specification Section 01300, Contractor Submittals Technical Specifications.
- B. Submittals shall include, but not be limited to, the following:
 - 1. Product data for all fence and gate components and accessories.
 - 2. Shop drawings showing layout, dimensions, and spacing of all fence and gate components, interface with electric gate operator, and anchorage and installation details including connection to masonry pillars.
 - 3. Coating color chart of available fence and gate colors for selection by Owner.
 - 4. Sample: 8 by 10 inches minimum size sample of fence panel illustrating design, fabrication workmanship, and selected color coating.
 - 5. Copy of warranty specified in Paragraph 1.05.

1.05 Warranty

Manufacturer shall provide 10 years (minimum) warranty for factory finish against cracking, peeling, and blistering.

1.06 Quality Assurance

Ornamental steel fencing and gates shall be as manufactured by Ameristar or equal.

PART 2 - PRODUCTS

2.01 Fencing

- A. Fence framework, including pickets, rails, and posts, shall be manufactured from electrically welded pre-galvanized tubing conforming to ASTM A513 and having minimum yield strength of 45,000 psi. Zinc coating with a minimum weight of 0.90 ounces per square foot (coating designation G-90) shall meet the requirements of ASTM 653.
- B. Fence panel sections shall be capable of supporting a 1000-pound load applied at the mid-span with deflection limited to L/240 and no permanent deformation.
- C. Pickets shall be minimum 1" square tubing with 14-gauge wall thickness, built on 5" centers for 4" nominal space between pickets. Unless shown otherwise on the Drawings, each picket shall be provided with a pressed and pointed top.
- D. Rails shall be minimum 1-3/4" square tubing with 11-gauge wall thickness.
- E. Posts shall be minimum 3" square tubing with 11-gauge wall thickness.

- F. Fence panel geometry, length, and height shall comply with the nominal dimensions shown on the Construction Drawings. Minor variations in dimensions may be necessary to accommodate actual field conditions and selected fence components.

Pickets, rails and posts shall be assembled in accordance with the manufacturer's approved shop drawings and the Construction Drawings. Prior to commencing fabrication, Contractor shall field verify all fence dimensions, including pillar, post locations, and fence segment lengths.

- G. Pickets, rails and posts shall be Electro-MIG welded per the final approved shop drawings. All joints shall be fully welded (seal welded) to prevent corrosion from moisture. Kit type field assembled fence panels are not acceptable.
- H. Posts shall be provided with zinc plated press-on type steel caps. Post bases shall be drilled base plate or sleeve for mounting to concrete footing or pier as indicated on the Construction Drawings.

2.02 Gates

A. General

Contractor shall provide gates of type and size indicated on the Drawings. Manufacturer shall equip gates with all hardware and appurtenances as required for complete functional operation.

Gate framework, including pickets, rails, and posts, shall be manufactured from structural tubing conforming to ASTM A36/A500 and having a minimum yield strength of 46,000 psi or from electrically welded pre-galvanized tubing conforming to ASTM A513 and having a minimum yield strength of 45,000 psi. All gate framework shall be provided with zinc coating with a minimum weight of 0.90 ounces per square foot (coating designation G-90) shall meet the requirements of ASTM A123/A653.

B. Hinged Swinging Gates

1. Construction: Frames fabricated from minimum 3" square steel tubing with 11-gauge wall thickness. Frames shall be fully welded. Unless shown otherwise on the Drawings, gate configuration shall be similar to fence sections. Gate pickets shall match fence pickets.
2. Gate Size: Gates shall be single or double with heights and widths as shown on the Drawings.
3. Hardware:
 - a. Hinges: Size and type as determined by manufacturer. Provide 2 hinges for each leaf up to 6 feet high and 1 additional hinge for each additional 24 inches in height or fraction thereof. Hinges shall be manufactured to allow 90-degree opening of gate(s).

- b. Latch: 3/4-inch diameter slide bolt to accommodate padlock.
- c. For double gates provide padlockable, 5/8-inch diameter center cane bolt assembly and strike.

C. V-Wheeled Rolling Gates

- 1. Construction: Frames fabricated from minimum 3" square steel tubing with 11-gauge wall thickness. Frames shall be fully welded. Unless shown otherwise on the Drawings, gate configuration shall be similar to fence sections. Gate pickets shall match fence pickets.
- 2. Gate Opening and Size: Gate opening shall be as shown on the Drawings. Gate height shall match adjacent fence or wall heights. Gate length and travel distance shall be as required to accommodate the gate support system and electric gate operator (where specified).
- 3. Support Posts: Pair of minimum 4" square steel tubing with 11-gauge wall thickness and solid cap.
- 4. Rolling Mechanism: Steel wheels with V-shaped edge groove and [[4] [6] inches] [[102] [152] mm] diameter, mounted to gate frame and riding on ground set V-track. Assembly braced at top by adjustable guide wheels mounted with brackets to support posts.

2.03 Accessories

- A. Unless specified otherwise, all fence and gate hardware and accessories shall be carbon steel or malleable iron.
- B. All fasteners shall be 304 (or better) stainless steel.
- C. All ferrous metal hardware and accessories shall be hot dipped galvanized and finish coated as specified herein.

2.04 Finish Coating

- A. Preparation: Upon completion of fabrication, all fence and gate assemblies shall receive a three stage pretreatment to clean and prepare galvanized surfaces for finish coating. First stage shall consist of iron phosphate surface pretreatment to clean and promote coating adhesion. Second stage shall consist of clean water rinse. Third stage shall consist of non-chromate conversion coating to seal all surfaces and provide additional corrosion protection.
- B. All fence and gate assemblies, including hardware and accessories, shall receive an electrostatically applied colored polyester powder coating heat cured to 450 degrees F to chemically bond finish to metal substrate. Polyester powder coating shall be applied to a thickness of 3 mils (minimum).
 - 1. Minimum hardness measured in accordance with ASTM D3363: 2H.

2. Direct impact resistance tested in accordance with ASTM D2794. Withstand 160 inch-pounds.
 3. Salt spray resistance tested in accordance with ASTM B117: No undercutting, rusting, or blistering after 500 hours in 5 percent salt spray at 95 degrees F and 95 percent relative humidity and after 1000 hours less than 3/16 inch undercutting.
 4. Weatherability tested in accordance with ASTM D822: No film failure and 85 percent (minimum) gloss retention after 1-year outdoor exposure.
- C. Color: Finish color shall be as selected by Owner. Manufacturer shall submit color chart to Owner showing all available colors.

PART 3 - EXECUTION

3.01 General

- A. Prior to fabrication, field verify required fence and gate dimensions.
- B. Contractor shall install fencing in accordance with manufacturer's written installation instructions and approved shop drawings.
- C. Verify areas to receive fencing are completed to final grades, elevations, and materials.
- D. Do not install bent, bowed, or otherwise damaged panels. Remove damaged components from site and replace.

3.02 Installation

- A. Where independent concrete footings are specified, provide footings in accordance with requirements herein, Specification Section 03300 - Cast-in-Place Concrete, and as shown on the Drawings and approved shop drawings.
 1. Post footing soil shall be firm and undisturbed.
 2. Minimum footing diameter:
 - a. Terminal fence posts and gate posts: 24 inches.
 - b. Intermediate fence line posts: 24 inches.
 3. Minimum post embedment:
 - a. Terminal fence posts and gate posts: 39 inches.
 - b. Intermediate fence line posts: 39 inches.

4. Provide 6 inches minimum concrete beneath post bottom.
 5. Trowel finish around posts and provide slope to direct water away from posts.
- B. Where fence installation is specified in existing concrete slabs or structures, core drill existing concrete for embedment of fence and gate posts. Core drill hole shall be 2 inches (minimum) greater than post width.
- C. Where fence and gate post installation is specified in precast sleeves, provide grout to fill post and sleeve. Grout shall be non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, and water reducing and plasticizing additives.
- D. Where surface mounting of posts is specified, provide flange type base plates with 4 holes. Anchor bolts shall be 304 stainless steel wedge anchors with size and embedment as required for design loads. Provide leveling nuts beneath base plate for post adjustment and fill space beneath plate with non-shrink grout, 3/4" minimum thickness.
- E. Fence and gate posts shall be installed plumb and level. Temporarily brace posts with 2 by 4 wood supports until concrete or grout is set.
- F. Gates:
1. Install gates and adjust hardware for smooth operation.
 2. Provide concrete center foundation for drop rod retainers at center of double swinging gate openings.
 3. Provide concrete foundation (6" minimum thickness) for length of operation of V-wheeled rolling gate. Anchor gate track to concrete with stainless steel countersunk fasteners.
 4. Upon completion of gate installation, test gate and electric operator (where specified). Adjust safety and control devices to provide proper operation. Correct deficiencies and adjust. Open and close gate a minimum of ten times without any difficulties.
- G. Touch-up damaged finish with paint supplied by manufacturer and matching original coating.

SECTION 03100
BASIC CONCRETE FORMWORK SPECIFICATIONS

PART 1 - GENERAL

1.01 General Requirements

Contractor shall furnish all materials for concrete formwork, bracing, shoring, and supports and shall design and construct all falsework, all in accordance with the provisions of the Contract Document.

1.02 Reference Specifications, Codes, and Standards

A. Codes

The Building Code, as referenced herein, shall be the California Building Code (CBC) of the California Building Standards Commission, latest edition.

B. Commercial Standards

ACI 347 Guide to Formwork for Concrete, latest edition.

1.03 Contractor Submittals

All submittals shall be in accordance with Section 01300, Contractor Submittals Technical Specifications.

A. Falsework Calculations and Drawings

Contractor shall comply with the provisions of Section 1717 of the Division of Industrial Safety, Construction Safety Orders, as revised November 1973, which requires that all falsework or vertical shoring installations where the heights of the falsework or vertical shoring, as measured from the top of the sills to the soffit of the superstructure, exceeds 14 feet, or where individual horizontal span lengths exceed 16 feet, or provision for vehicular or railroad traffic through falsework or vertical shoring is made, shall be approved and signed by a Civil Engineer, registered in the State of California; provided further, that a copy of the falsework plan or shoring layout shall be available on the job site at all times.

B. Contractor shall submit detailed plans of the falsework proposed to be used. Such plans shall be in sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the falsework, and typical soil conditions.

1.04 Quality Assurance

Tolerances

The variation from established grade, line, plumbness, or thickness shall be as set forth in Part 1.04F of Section 03300, Basic Concrete Specifications, and there shall be no offsets or

visible waviness in the finished surface. All other tolerances shall be as specified in Chapter 3 of ACI 347.

PART 2 - PRODUCTS

2.01 General

Except as otherwise expressly accepted by the Engineer, all lumber brought on the job site for use a forms, shoring, or bracing shall be new materials. All forms shall be smooth surface forms and shall be of the following materials:

Walls	-	Steel or plywood panel
Columns	-	Steel, plywood, or fiber glass
Roof and Floor slabs	-	Plywood
All other work	-	Steel panels, plywood or tongue and groove lumber

2.02 Form and Falsework Materials

A. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:

1. Lumber shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20, American Softwood Lumber Standard.
2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS 1, Structural Plywood, for Concrete Forms, Class I, and shall be edge sealed.
3. Form materials shall be metal, wood, plywood, or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade shown. Metal forms shall be an approved type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

B. Unless otherwise shown, exposed edges and corners in concrete members shall be provided with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise shown.

C. Forms and falsework to support the roof and floor slabs shall be designed for the total dead load, plus a live load of 30 psf (minimum).

2.03 Form Ties

A. Form ties with integral waterstops shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed

1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming.

- B. Form ties for water-retaining structures shall have integral waterstops. Removable taper ties may be used when approved by the Engineer. A preformed neoprene or polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie.

PART 3 - EXECUTION

3.01 General

- A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. Contractor shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the work and replaced at the Contractor's expense. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, state and federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by the Contractor's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement, the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.
- B. Concrete forms shall conform to the shape, lines, and dimensions of members as called for on the Contract Drawings, and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

3.02 Form Design

All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. Forms shall be tight so as to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1 to 1-1/2 inch diameter polyethylene rod held in position to the underside of the wall form. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be as acceptable to the Engineer.

3.03 Construction

A. Vertical Surfaces

All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is shown. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

B. Construction Joints

Concrete construction joints shall not be placed at locations other than those shown or specified, except as may be acceptable to the Engineer. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

C. Form Ties

1. **Embedded Ties:** Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified in Part 3.12C of Section 03300, Basic Concrete Specifications. Wire ties for holding forms shall not be used. Form-tying devices or parts thereof, other than metal, shall not be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. Contractor shall not use snap-ties which cause spalling of the concrete upon form stripping or tie removal. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.
2. **Removable Ties:** Where taper ties are approved for use, the larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for water bearing and below-grade walls. The hole shall be completely filled with non-shrink or regular cement grout for above-grade walls which are dry on both sides. Exposed faces of walls shall have the outer 2 inches of the exposed face filled with a cement grout which shall match the color and texture of the surrounding wall surface.

3.04 Reuse of Forms

Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the Engineer.

3.05 Removal of Forms

Careful procedures for the removal of forms shall be strictly followed, and this work shall be done with care so as to avoid injury to the concrete. Contractor shall not apply heavy loading on green concrete. In the case of roof slabs and above-ground floor slabs, forms shall remain in place until test cylinders for the roof concrete attain a minimum compressive strength of 75 percent of the 28-day strength specified in Section 03300, Basic Concrete Specifications; provided, that no forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained 75 percent of the specified 28-day strength and has been in place for a minimum of 14 days. The time required to establish said strength shall be as determined by the Engineer who will make several test cylinders for this purpose from concrete used in the first group of roof panels placed. If the time so determined is more than the 14-day minimum, then that time shall be used as the minimum length of time. Forms for all vertical foundations, walls, and columns shall remain in place at least 48 hours after the concrete has been placed (commencing from the time the last concrete is placed for that day). Forms for all parts of the work not specifically mentioned herein shall remain in place for periods of time as determined by the Engineer.

3.06 Maintenance of Forms

Forms shall be maintained at all times in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Forms, when in place, shall conform to the established alignment and grades. Before concrete is placed, forms shall be thoroughly cleaned. Form surfaces shall be treated with a nonstaining mineral oil or other lubricant acceptable to the Engineer. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, Contractor shall perform the oiling at least two weeks in advance of their use. Oil shall be kept off the surfaces of steel reinforcement and other metal items to be embedded in concrete. If oil is inadvertently placed on said metal surfaces, Contractor shall remove oil by sandblasting.

3.07 Falsework

- A. Contractor shall be responsible for the design, engineering, construction, maintenance, and safety of all falsework, including staging, walkways, forms, ladders, and similar appurtenances, which shall equal or exceed the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, the requirements of the Construction Safety Orders of the California Division of Industrial Safety, and the requirements specified herein.

- B. All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure were placed at one time.
- C. Falsework shall be placed upon a solid footing, safe against undermining, and protected from softening. When the falsework is supported on timber piles, the maximum calculated pile loading shall not exceed 20 tons. When falsework is supported on any portion of the structure which is already constructed, the load imposed by the falsework shall be spread, distributed, and braced in such a way as to avoid any possibility of damage to the structure.

END OF SECTION

SECTION 03200
BASIC CONCRETE REINFORCEMENT SPECIFICATIONS

PART 1 - GENERAL

1.01 General Requirements

Contractor shall furnish, fabricate, and place all concrete reinforcement steel, welded wire reinforcement, couplers, and concrete inserts for use in reinforced concrete and masonry construction and shall perform all appurtenant work, including all the wires, clips, supports, chairs, spacers, and other accessories, all in accordance with the Contract Documents.

1.02 Reference Specifications, Codes, and Standards

A. Codes

The Building Code, as referenced herein, shall be the California Building Code (CBC) of the California Building Standards Commission, latest edition.

B. Commercial Standards

Where not covered in this specification, all work shall comply with the following standards, latest editions:

ACI 315	Details and Detailing of Concrete Reinforcement.
ACI 318	Building Code Requirements for Structural Concrete and Commentary.
WRI	Manual of Standard Practice for Structural Welded Wire Reinforcement.
AWS D1.4	Structural Welding Code - Reinforcing Steel.
CRSI	Manual of Standard Practice.

1.03 Contractor Submittals

All submittals shall be in accordance with the Contractor Submittals Technical Specifications, Section 01300.

- A. Contractor shall furnish shop bending diagrams, placing lists, and drawings of all reinforcement steel prior to fabrication.
- B. Details of concrete reinforcement steel and concrete inserts shall be submitted by the Contractor at the earliest possible date after receipt by the Contractor of Notice to Proceed. Said details of reinforcement steel for fabrication and erection shall conform to ACI 315 and the requirements specified and shown. Shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the

extensions (tangents for bars of circular cross section) of the outside surface. Shop drawings shall include bar placement diagrams which clearly indicate the dimensions of each bar splice.

- C. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, Contractor shall submit manufacturer's literature which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and shop drawings which show the location of each coupler with details of how they are to be installed in the formwork.
- D. If reinforcement steel is spliced by welding at any location, Contractor shall submit mill test reports which shall contain the information necessary for the determination of the carbon equivalent as specified in AWS D1.4. Contractor shall submit a written welding procedure for each type of weld for each size of bar which is to be spliced by welding; merely a statement that AWS procedures will be followed is not acceptable.

1.04 Quality Assurance

- A. If requested by the Engineer, Contractor shall provide samples from each heat of reinforcement steel delivered in a quantity adequate for testing. Costs of initial tests will be paid by the Owner. Costs of additional tests due to material failing initial tests shall be paid by the Contractor.
- B. If reinforcement steel is spliced by welding at any location, Contractor shall submit certifications of procedure qualifications for each welding procedure used and certification of welder qualifications, for each welding procedure, and for each welder performing the work. Such qualifications shall be as specified in AWS D1.4.
- C. If requested by the Engineer, Contractor shall provide samples of each type of welded splice used in the work in a quantity and of dimensions adequate for testing. At the discretion of the Engineer, radiographic testing of direct butt welded splices will be performed. Contractor shall provide assistance necessary to facilitate testing. Contractor shall repair any weld which fails to meet the requirements of AWS D1.4. The costs of testing will be paid by the Owner; except, the costs of all tests which fail to meet specified requirements shall be paid by the Contractor.

PART 2 - PRODUCTS

2.01 Reinforcement Steel

- A. All reinforcement steel for all cast-in-place reinforced concrete construction shall conform to the following requirements:
 - 1. Bar reinforcement shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel Reinforcement with supplementary requirement S-1, or as otherwise shown.

2. Welded wire reinforcement shall conform to the requirements of ASTM A 185 and the details shown; provided, that welded wire reinforcement with longitudinal wire of W9.5 size wire shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire reinforcement with longitudinal wires larger than W9.5 size shall be furnished in flat sheets only.
3. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A 82.

B. Accessories

1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. Slab bolsters shall have gray plastic-coated legs.
2. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Where the concrete blocks are used on concrete surfaces exposed to view, the color and texture of the concrete blocks shall match that required for the finished surface. Wire ties shall be embedded in concrete block bar supports.

2.02 Mechanical Couplers

- A. Mechanical couplers shall be provided where shown and where approved by the Engineer. The couplers shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcement bars being spliced at each splice.
- B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied. This shall apply to all mechanical splices, including those splices intended for future connections.
- C. The reinforcement steel and coupler used shall be compatible for obtaining the required strength of the connection.
- D. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as shown. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. After the concrete is placed, Contractor shall plug and seal couplers intended for future connections to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged with plastic plugs which have an O-ring seal.

2.03 Welded Splices

- A. Welded splices shall be provided where shown and where approved by the Engineer. All welded splices of reinforcement steel shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcement bars which are connected.

- B. All materials required to perform the welded splices to the requirements of AWS D1.4 shall be provided.

PART 3 - EXECUTION

3.01 General

All reinforcement steel, welded wire reinforcement, couplers, and other appurtenances shall be fabricated, and placed in accordance with the requirements of the Building Code and the supplementary requirements specified herein.

3.02 Fabrication

A. General

Reinforcement steel shall be accurately formed to the dimensions and shapes shown, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings. Stirrups and tie bars shall be bent around a pin having a diameter not less than 1-1/2 inch for No. 3 bars, 2-inch for No. 4 bars, and 2-1/2 inch for No. 5 bars. Bends for other bars shall be made around a pin having a diameter not less than 6 times the minimum thickness, except for bars larger than 1 inch, in which case the bends shall be made around a pin of 8 bar diameters. Bars shall be bent cold.

- B. Contractor shall fabricate reinforcement bars for structures in accordance with bending diagrams, placing lists, and placing drawings.

C. Fabricating Tolerances

Bars used for concrete reinforcement shall meet the following requirements for fabricating tolerances:

1. Sheared length: ± 1 inch
2. Depth of truss bars: $+ 0, - 1/2$ inch
3. Stirrups, ties, and spirals: $\pm 1/2$ inch
4. All other bends: $+ 1$ inch

3.03 Placing

A. Placing

Reinforcement steel shall be accurately positioned as shown, and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcement steel shall be supported by concrete, plastic or metal supports, spaces or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the

bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, Contractor shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.

- B. The portions of all accessories in contact with the formwork shall be made of concrete, plastic, or steel coated with a 1/8 inch minimum thickness of plastic which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.
- C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
- D. Bars additional to those shown which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at its own expense.

E. Placing Tolerances

Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5, Placing Reinforcement, of ACI 318 except where in conflict with the requirements of the Building Code.

- F. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer.
- G. Welded wire reinforcement placed over horizontal forms shall be supported on slab bolsters having gray, plastic-coated standard type legs as specified in Paragraph B herein. Slab bolsters shall be spaced not less than 30 inches on centers, shall extend continuously across the entire width of the reinforcement mat, and shall support the reinforcement mat in the plane shown.
- H. Welded wire reinforcement placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction. Contractor shall not utilize the construction practice of placing welded wire reinforcement on the ground and hooking into place in the freshly placed concrete.

3.04 Spacing of Bars

- A. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than 1 inch.
- B. Where reinforcement in beams or girders is placed in 2 or more layers, the clear distance between layers shall be not less than 1 inch.
- C. In columns, the clear distance between longitudinal bars shall be not less than 1-1/2 times the bar diameter, not less than 1-1/2 times the maximum size of the coarse aggregate, nor less than 1-1/2 inches.

- D. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.

3.05 Splicing

- A. General

Reinforcement bar splices shall only be used at locations shown. When it is necessary to splice reinforcement at points other than where shown, the character of the splice shall be as acceptable to the Engineer.

- B. Splices of Reinforcement

The length of lap for reinforcement bars, unless otherwise shown shall be in accordance with ACI 318, Section 12.15.1 for a Class B splice.

- C. Laps of welded wire reinforcement shall be in accordance with the ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

- D. Splices in column spiral reinforcement, when necessary, shall be made by welding or by a lap of 1-1/2 turns.

- E. Bending or Straightening

Reinforcement shall not be straightened or rebent in a manner which will injure the material. Bars with kinks or bends not shown shall not be used. All bars shall be bent cold, unless otherwise permitted by the Engineer. No bars partially embedded in concrete shall be field-bent except as shown or specifically permitted by the Engineer.

3.06 Cleaning and Protection

- A. Reinforcement steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.
- B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be reinspected and, if necessary recleaned.

END OF SECTION

SECTION 03300
BASIC CONCRETE SPECIFICATIONS

PART 1 - GENERAL

1.01 General Requirements

- A. Contractor shall furnish all materials for concrete in accordance with the provisions of this Section and shall form, mix, place, cure, repair, finish, and do all other work as required to produce finished concrete, all in accordance with the requirements of the Contract Documents.
- B. All cast-in-place concrete falls into one of the following categories and shall comply with all requirements of this basic specification.
1. Structural Concrete (or Class "A" Concrete). Concrete to be used in all cases except where noted otherwise in the Contract Documents.
 2. Sitework Concrete (or Class "B" Concrete). Concrete to be used for curbs, gutters, catch basins, sidewalks, pavements, fence and guard post embedment, underground duct bank encasement and all other concrete appurtenant to electrical facilities unless otherwise shown.
 3. Lean Concrete (or Class "C" Concrete). Concrete to be used for thrust blocks, pipe trench cut-off blocks and cradles, where the preceding items are detailed on the drawings as unreinforced. Concrete to be used as protective cover for dowels intended for future connection.
- C. Only one class of concrete shall be present at the job site at any one time.

1.02 Reference Specifications, Codes, and Standards

A. Specifications

Items specified elsewhere in these Contract Documents:

Concrete Formwork - See Section 03100, Basic Concrete Formwork Specifications.

Concrete Reinforcement - See Section 03200, Basic Concrete Reinforcement Specifications.

B. Codes

The Building Code, as referenced herein, shall be the California Building Code (CBC), of the California Building Standards Commission, latest edition.

C. Commercial Standards

Where not covered in this specification, all work shall comply with the following standards, latest editions:

ACI 214	Evaluation of Strength Test Results of Concrete
ACI 301	Specifications for Structural Concrete
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 347	Guide to Formwork for Concrete
ACI 318	Building Code Requirements for Structural Concrete and Commentary
ACI 350	Code Requirements for Environmental Engineering Concrete Structures and Commentary
ASTM C 494	Standard Specification for Chemical Admixtures for Concrete

1.03 Contractor Submittals

All submittals shall be in accordance with the Section 01300, Contractor Submittals Technical Specifications.

A. Mix Designs

Prior to beginning the work, Contractor shall submit to Engineer, for review, preliminary concrete mix designs which shall show the proportions and gradations of all materials proposed for each class and type of concrete to be used on the job. The mix designs shall be designed by an independent testing laboratory acceptable to Engineer. All costs related to such mix design shall be borne by the Contractor.

B. Certified Delivery Tickets

Where ready-mix concrete is used, Contractor shall provide certified delivery tickets at the time of delivery of each load of concrete. Each certificate shall show the total quantities (by weight) of cement, sand, each class of aggregate, and admixtures, and the amounts of water (by gallons) in the aggregate and added at the batching plant as well as the amount of water allowed to be added at the site for the specific design mix. Each certificate shall, in addition, state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to when the batch was dispatched, when it left the plant, when it arrived at the job, the time that unloading began, and the time that unloading was finished.

1.04 Quality Assurance

A. Tests on component materials and for compressive strength of concrete will be performed as specified herein. Test for determining slump will be in accordance with the requirements of ASTM C 143.

- B. The cost of all laboratory tests on concrete will be borne by the Owner. However, Contractor shall be charged for the cost of any additional tests and investigation on work performed which fails to meet specification.
- C. Concrete for testing shall be supplied by Contractor at no cost to the Owner, and Contractor shall provide assistance to the Engineer in obtaining samples, and disposal and cleanup of excess material.

D. Field Compression Tests

1. Compression test specimens will be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the Engineer to insure continued compliance with these specifications. Each set of test specimens will be a minimum of 4 cylinders.
2. Compression test specimens for concrete shall be made in accordance with ASTM C 31. Specimens shall be 6" diameter by 12" high cylinders.
3. Compression tests shall be performed in accordance with ASTM C 39. One test cylinder will be tested at 7 days and two will be tested at 28 days.

The remaining cylinder will be held to verify test results, if needed.

E. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 350, Chapter 5, "Concrete Quality, Mixing, and Placing", and as specified herein.
2. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.
3. All concrete which fails to meet the ACI requirements and these specifications is subject to removal and replacement at the cost of the Contractor.

F. Construction Tolerances

Contractor shall set and maintain concrete forms and perform finishing operations so as to insure that the completed work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the specifications, permissible deviations will be in accordance with ACI 347.

- G. The following construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown:

<u>Item</u>	<u>Tolerance</u>
Variation of the constructed linear outline from the established position in plan	In 10 feet: 1/4 inch; In 20 feet or more: 1/2 inch
Variation from the level or from the grades shown	In 10 feet: 1/8 inch; In 20 feet or more: 1/4 inch
Variation from the plumb	In 10 feet: 1/8 inch; In 20 feet or more: 1/4 inch
Variation in the thickness of slabs and walls	Minus 1/4 inch; Plus 1/2 inch
Variation in the locations and sizes of slab and wall openings	Plus or minus 1/4 inch

Regardless of the tolerances listed herein, it shall be the responsibility of the Contractor to limit deviations in line and grade to tolerances which will permit proper installation and operation of mechanical equipment and piping.

PART 2 - PRODUCTS

2.01 Concrete Materials

- A. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.
- B. All materials furnished for the work shall comply with the requirements of Section 4.2.1 of ACI 301.
- C. Storage of materials shall conform to the requirements of Section 4.1.4 of ACI 301.
- D. Materials for concrete shall conform to the following requirements:
- Cement shall be standard brand portland cement conforming to ASTM C 150 for Type II or Type V. Portland cement shall contain not more than 0.60 percent alkalis. A single brand of cement shall be used throughout the work, and prior to its use, the brand shall be acceptable to the Engineer. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Stacked cement shall be stored in such a manner so as to permit access for inspection and sampling. Certified mill test reports for each shipment of cement to be used shall be submitted to the Engineer if requested regarding compliance with these specifications.

2. Fly Ash or other pozzolans are not permitted as a component in the concrete mix.
3. Water shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purposes of this section only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids (over 1000 mg/l TDS) shall not be used.
4. Aggregates shall be obtained from pits acceptable to the Engineer, shall be non-reactive, and shall conform to ASTM C 33. Maximum size of coarse aggregate shall be as specified in Paragraph 2.07B herein. Lightweight sand for fine aggregate will not be permitted.
 - a. Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock or a combination thereof. The coarse aggregates shall be prepared and handled in two or more size groups for combined aggregates with a maximum size greater than 3/4". When the aggregates are proportioned for each batch of concrete the two size groups shall be combined.
 - b. Fine aggregates shall be natural sand or a combination of natural and manufactured sand that are hard and durable.
 - c. Combined aggregates shall be well graded from coarse to fine sizes, and shall be uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.
5. Ready-mix concrete shall conform to the requirements of ASTM C 94.
6. Air-entraining agent meeting the requirements of ASTM C 260, shall be used. Sufficient air-entraining agent shall be used to provide a total air content of 4 to 6 percent; provided that, when the mean daily temperature in the vicinity of the worksite falls below 40°F for more than one day, the total air content provided shall be 5 to 7 percent. The Owner reserves the right, at any time, to sample and test the air-entraining agent received on the job by the Contractor. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement.
7. Admixtures shall be required as stated herein and at the Engineer's discretion or, if not required, may be added at the Contractor's option to control the set, effect water reduction, and increase workability. In either case, the addition of an admixture shall be at the Contractor's expense. The use of an admixture shall be subject to acceptance by the Engineer. Concrete containing an admixture shall be first placed at a location determined by the Engineer. If the use of an admixture is producing an inferior end result, Contractor shall discontinue use of the admixture. Admixtures specified herein shall conform to the requirements of

ASTM C 494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used. Admixtures shall contain no free chloride ions, be non-toxic after 30 days, and shall be compatible with and made by the same manufacturer as the air entraining admixture.

- a. Low range water reducer shall be used in all structural and sitework concrete and shall conform to ASTM C 494, Type A. It shall be either a hydroxylated carboxylic acid type or a hydroxylated polymer type. The quantity of admixture used and the method of mixing shall be in accordance with the manufacturer's instructions and recommendations.
- b. Set controlling admixture shall be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80°F, a set retarding admixture such as Sika Chemical Corporation's Plastiment, BASF's Pozzolith 300R, or equal shall be used. Where the air temperature at the time of placement is expected to be consistently under 40°F, a set accelerating admixture such as Sika Chemical Corporation's Plastocrete 161FL, BASF's Pozzolith 122HE, or equal shall be used.
- c. High range water reducer may be used if approved by Engineer. If allowed it shall be sulfonated polymer conforming to ASTM C 494, Type F or G.

High range water reducing agent shall only be added to the concrete at the batch plant. It shall be second generation type, Daracem 100 as manufactured by W.R. Grace & Co., Rhedbuild 1000 as manufactured by BASF, or equal. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified.

Concrete shall be mixed at mixing speed for a minimum of 30 mixer revolutions after the addition of the high range water reducer.

8. Calcium Chloride shall not be added to or used in concrete.
9. Floor Hardener shall be provided where specified on the Drawings. Floor hardener shall be natural aggregate dry shake hardener for concrete. Hardener shall be composed of crushed, washed, and specially graded quartz silica aggregate, cementitious binders, plasticizers, dispersing agents and stable colorants. Contractor shall coordinate adjustments in concrete mix design necessary to accommodate proposed floor hardener, including air entrainment and admixtures. Unless specified otherwise, hardener color shall be natural light gray.

Floor hardener shall be ConColor by ChemMasters, Lithochrome by L.M. Scofield Co., Colorcron by Master Builders, or equal. Floor hardener shall be applied in strict accordance with the manufacturer's printed instructions.

2.02 Curing Materials

Materials for curing concrete shall conform to the following requirements:

- A. Concrete curing compound shall be Resi-Chem manufactured by Symons, or approved equal. The curing compound shall contain a fugitive dye so that areas of application will be readily distinguishable.
- B. Polyethylene sheet for use as concrete curing blanket shall be white, and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C 156 shall not exceed 0.055 grams per square centimeter of surface.
- C. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, having a nominal thickness of 2 mils and permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A (Int. Amd. 1). The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 gram per square centimeter of surface.
- D. Polyethylene-coated burlap for use as concrete curing blanket shall be 4 mil thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 grams per square centimeter of surface.
- E. Curing mats for use in Curing Method 6 as specified in Paragraph 3.09G herein, shall be heavy shag rugs or carpets or cotton mats quilted at 4" on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.
- F. Evaporation retardant shall be a material such as Confilm as manufactured by BASF, Cleveland, OH; or equal.

2.03 Waterstop

- A. Contractor shall provide waterstops at all construction and expansion joints in all water holding structures. Waterstop shall be Greenstreak PVC Style 732, 6" wide, or Style 735, 9" wide, as specified on Drawings.
- B. Contractor shall heat fuse joints and connections in strict compliance with manufacturer's instructions using heating tools and devices recommended by same. Waterstops shall be continuous in joints, following offsets and angles in joint until spliced to waterstops at intersecting joints, completely sealing the structure. Waterstops shall be aligned and centered in joints. Contractor shall secure flanges of waterstops to reinforcing bars with 18 gauge wire ties spaced maximum 18" on center. Waterstop joints shall be properly heat-spliced at ends and crosses to preserve continuity. Contractor shall locate waterstops where shown on drawings and in all waterbearing walls and slabs where common to: earth-bearing or earth-support; occupied areas; or above-grade exposed surfaces.

- C. All joints with waterstops involving more than 2 ends to be jointed together, and all joints which involve an angle cut, alignment change, or the joining of 2 dissimilar waterstop sections shall be prefabricated by the Contractor prior to placement in the forms, allowing not less than 24" long strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated waterstop joint assemblies shall be butt welded to the straight run portions of waterstop.
- D. Waterstop splices shall have a tensile strength of not less than 60 percent of the unspliced materials tensile strength.

2.04 Expansion Joints

- A. Contractor shall provide expansion joints where indicated on Construction Drawings. Expansion joints shall consist of joint filler material and joint sealant. Filler material shall be held down 1/2" for sealant unless otherwise shown.
- B. Expansion joint filler material shall be preformed sponge neoprene or cork conforming to ASTM D 1752. Filler material containing asphalt shall not be used.

2.05 Joint Sealant

- A. Joint sealant for use in construction, control, and expansion joints shall be Sika-Flex 1a as supplied by the Sika Corporation, or approved equal.

Joint primer shall be as produced and/or recommended by sealant manufacturer.
- B. Contractor shall clean all locations where sealant is placed by sandblasting and be free from oil, foreign materials, and moisture. Lower surfaces of joints shall be isolated with a bond breaker such as polyethylene, polyethylene tape, or equal as recommended by sealant manufacturer.
- C. Sealant shall be placed in strict accordance with manufacturer's recommendations by a firm specializing in this type of work, or by the Contractor under direct supervision of the manufacturer. If the Contractor chooses to apply sealant, manufacturer's technical representative shall be present at the beginning of sealant placement to observe and advise on methods for mixing, joint preparation, and application of sealant.

2.06 Concrete Bond Breaker

- A. Bond breaker shall be Spec Tilt WB Bond Breaker as manufactured by SpecChem; Tilt-EEZ WB Bond Breaker as manufactured by Conspec; or approved equal. It shall contain a fugitive dye so that areas of application will be readily distinguishable.
- B. Contractor shall strictly follow manufacturer's application guidelines. Just prior to application, joint shall be thoroughly soaked so that concrete contains approximately the same surface moisture as newly cast concrete. Bond breaker shall be brush applied with a minimum of two coats. Extreme care must be taken to prevent any bond breaker from contacting waterstops. If necessary, wrap waterstop during bond breaker application.

2.07 Concrete Design Requirements

A. General

Concrete shall be composed of cement, admixtures, aggregates and water. The materials shall be of the qualities specified. The exact proportions in which the materials are to be used for different parts of the work will be determined during the batch. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, when deposited in forms, to have good consolidation properties and maximum smoothness of surface. Mix designs shall not contain more than 43 percent of sand of the total weight of fine and coarse aggregate. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the Owner. All changes shall be approved by the Engineer.

B. Water-Cement Ratio and Compressive Strength

The minimum compressive strength and cement content of concrete shall be not less than that specified in the following tabulation.

<u>Type of Work</u>	<u>Min. 28-Day Compressive Strength (psi)</u>	<u>Max. Size Aggregate (in.)</u>	<u>Min. Cement per cu yd (sacks)</u>	<u>Max. W/C Ratio (by wt.)</u>
Structural Concrete (Class "A"):				
Walls, floor slabs, columns, and footings of hydraulic (water or wastewater) bearing structures	4,000	1	6.2	0.45
Walls, roof slabs, floor slabs, columns, and footings and all other concrete items not specified elsewhere	4,000	1	6.2	0.48
Sitework concrete (Class "B"):	3,000	1	5.5	0.52
Lean concrete (Class "C"):	2,000	1	4.0	0.60

Note: One sack of cement equals 94 lbs.

Adjustments to Mix Design

Mixes used shall be changed whenever required strength, density, workability, and surface finish and Contractor stipulated to no additional compensation because of such changes. Approval shall be obtained from Engineer prior to any changes.

Consistency

The quantity of water entering into a batch of concrete shall be just sufficient, with normal mixing period, to produce concrete which can be worked properly into place without segregation, and which can be compacted by vibratory methods herein specified to give desired density, impermeability and smoothness of surface. The quantity of water shall be changed as necessary, with variations in the nature of moisture content of the aggregates, to maintain uniform production of desired consistency. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slumps shall be as follows:

Part of Work	Slump
Structural concrete	3" ($\pm 1"$)
Other work	4" ($\pm 1"$)
With high range water reducer added	8" max.

Ready-Mixed Concrete

- A. At Contractor's option, ready-mixed concrete may be used provided it meets all requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94, including the supplementary requirements specified in Paragraphs 2.09B through 2.09F herein.
- B. Ready-mixed concrete shall be delivered to the site of the work, and discharge shall be completed within 90 minutes after the addition of the cement to the aggregates or the drum has been revolved 250 revolutions, whichever is first. In hot weather (ambient temperature above 95°F) or under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85°F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes.
- C. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
- D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.

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- E. Truck mixers and their operation shall be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than 1" when the specified slump is 4" or less, or if they differ by more than 2" when the specified slump is more than 4", the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
- F. Each batch of ready-mixed concrete delivered at the job site shall be accompanied by a certified weighmaster delivery ticket furnished to the Engineer in accordance with Paragraph 1.03B herein.
- G. Non-agitating equipment for transporting ready-mixed concrete shall not be used. Combination truck and trailer equipment for transporting ready-mixed concrete shall not be used. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates may be subject to continuous inspection at the batching plant by the Engineer.
- H. Transit mix trucks delivering concrete to the site shall have full water tanks upon arrival at the site. Any addition of water must be approved by Engineer. Added water must be incorporated by additional mixing of at least 35 revolutions.

PART 3 - EXECUTION

3.01 Proportioning and Mixing

A. Proportioning

Proportioning of the concrete mix shall conform to the requirements of Section 4.2.3 of ACI 301; provided, that the maximum slump for any concrete shall not exceed 4" except when the use of high range water reducer is permitted which increases the maximum slump to 8".

B. Mixing

Mixing of concrete shall conform to the requirements of Section 4.3.1 of ACI 301 specifications.

C. Slump

Maximum slumps shall be as specified in Paragraph 2.08A herein.

D. Retempering

Concrete or mortar which has partially hardened shall not be retempered.

3.02 Preparation of Surfaces for Concreting

A. General

Earth surfaces shall be thoroughly wetted by sprinkling, prior to placing any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. These surfaces shall be free from standing water, mud, and debris at the time of placing concrete.

B. Joints in Concrete

The location of all construction joints not specifically noted or shown shall be approved by Engineer. Concrete surfaces upon or against which concrete is to be placed, where the placement of the old concrete has been stopped or interrupted so that, as determined by the Engineer, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bond. Except where the drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of all laitance, loose or defective concrete, and foreign material. Such cleaning shall be accomplished by sandblasting to remove laitance and to provide a uniform surface texture with approximately 1/4" of surface sandblasted off. Sandblasting shall be followed by thorough washing. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.

C. Placing Interruptions

When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means, that will secure proper union with subsequent work; provided that construction joints shall be made only where acceptable to the Engineer.

D. Embedded Items

1. Concrete shall not be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the Engineer at least 4 hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.
2. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where shown on Contract Drawings and shall be acceptable to the Engineer before any concrete is placed. Accuracy of placement is the responsibility of the Contractor.
3. Anchor Bolts shall be accurately set, and shall be maintained in position by templates while being embedded in concrete.

4. Concrete anchor bolts and expansion anchors shall be ASTM type A-316 stainless steel and shall be inserted to the minimum depths listed below, unless noted otherwise:

<u>Size</u>	<u>Reinforced Concrete</u>
1/4"	3"
3/8"	4"
1/2"	5"
3/4"	6"

5. Expansion anchors shall be stainless steel Hilti Kwik Bolt TZ, or equal.
6. All smooth dowels shall have at least one side coated with a bond breaker. Dowel bond breaker shall be a heavy duty industrial grease hand applied. A wax paper or PVC sleeve may be used at the Contractor's option if specifically manufactured to create slip dowels. Paper tubing shall be multi-ply stock and heavily impregnated with paraffin. Maximum sleeve thickness shall be 1/16" and sleeve shall fit snugly over dowel.

E. Casting New Concrete Against Old

1. Where new concrete is to be cast against existing (old) concrete (concrete which is greater than 60 days of age), surfaces of old concrete shall be roughened by mechanical means to provide an aggregate-fractured surface with a 1/4" (min.) profile and cleaned of all loose concrete and dust. The remaining surface shall be saturated in advance of concrete placement but be free of standing water. A bonding agent such as Sika Armatex 110 shall be applied to the interface between old and new concrete just prior to concrete placement.
2. Overlays of existing concrete and repair of holes, cavities, and depressions in existing concrete due to removal of existing facilities or installation of new facilities shall be as follows:
 - a. Remaining concrete surfaces shall be prepared as specified in Paragraph 3.02E.1 herein.
 - b. A bonding agent shall be applied to all concrete and metal surfaces to receive repair mortar or concrete. Bonding agent shall be Sika Armatex 110, or equal.
 - c. Overlays, holes, cavities, and depressions shall be filled with Sika Monotop 611 mortar, or equal. For placements greater than 1" in depth, 3/8" coarse aggregate shall be added to the mortar to create a repair concrete. Vertical surfaces shall be formed. Horizontal surfaces, including slab overlays, shall be hand troweled and finished to match adjacent concrete.

d. Bonding agent and repair mortar/concrete shall be mixed and installed in strict accordance with the manufacturer's printed instructions.

F. Concrete shall not be placed in any old or new structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the work. Concrete shall not be deposited underwater nor shall the Contractor allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such a manner and at such velocity as to injure the surface finish of the concrete. Contractor shall provide pumping or other necessary dewatering operations for removing groundwater, if required, with methods subject to review by Engineer.

G. Corrosion Protection

Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2" clearance between said items and any part of the concrete reinforcement. Contractor shall not secure such items in position by wiring or welding them to the reinforcement.

H. Cleaning

Surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before concrete is placed.

3.03 Handling, Transporting, and Placing

A. General

Placing of concrete shall conform to the applicable requirements of Section 5.3.2 of ACI 301 and the requirements of this Section.

B. Non-Conforming Work or Materials

Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the work. Concrete which is not placed in accordance with these specifications, or which is of inferior quality, shall be removed and replaced by and at the expense of the Contractor.

C. Unauthorized Placement

Concrete shall not be placed except in the presence of duly authorized representative of the Engineer. Contractor shall notify Engineer at least 24 hours in advance of placement of any concrete.

D. Placement in Wall Forms

Concrete shall not be dropped through reinforcement steel or into any deep form, whether reinforcement is present or not, causing separation of the coarse aggregate from the mortar on account of repeatedly hitting rods or the sides of the form as it falls, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4' below the ends of ducts, chutes, or buggies. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6' in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2'; and Contractor shall take care to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft.

E. Placement in Slabs

Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement. As the work progresses, concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.

F. Temperature of Concrete

Temperatures of concrete when it is being placed shall be not more than 90°F nor less than 40°F in moderate weather, and not less than 50°F in weather during which the mean daily temperature drops below 40°F. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90°F, Contractor shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90°F. Contractor shall be entitled to no additional compensation on account of the foregoing requirements.

G. Cold Weather Placement

Earth foundations shall be free from frost or ice when concrete is placed upon or against them. Fly ash concrete shall not be placed when the air temperature falls below 50°F.

3.04 **Pumping of Concrete**

A. General

If the pumped concrete does not produce satisfactory end results, Contractor shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

B. Pumping Equipment

Pumping equipment must have 2 cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, Contractor may have a standby pump on the site during pumping.

C. The minimum diameter of hose (conduits) shall be 4".

D. Contractor shall replace pumping equipment and hoses (conduits) that are not functioning properly.

E. Contractor shall not use aluminum conduits for conveying the concrete.

F. Proportioning

Minimum compressive strength, cement content, and maximum size of aggregates shall be as specified in Paragraph 2.07 herein.

G. Gradation of coarse aggregates shall conform to ASTM C 33 and shall be as close to the middle range as possible.

H. Gradation of fine aggregate shall conform to ASTM C 33, with 15 to 30 percent passing the number 50 screen and 5 to 10 percent passing the number 100 screen. The fineness modulus of sand used shall not be over 3.00.

I. Water and slump requirements shall conform to Paragraphs 2.01D.2 and 2.07B herein for water and Paragraph 2.08A herein for slump.

J. Cement and admixtures shall conform to Paragraph 2.01D herein.

3.05 Order of Placing Concrete

The order of placing concrete in all parts of the work shall be acceptable to the Engineer. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured before the contiguous unit or units are placed, as follows:

A. Foundations

Foundation forms shall remain in place for a minimum of 48 hours after the end of a placement. Thereafter, forms may be removed and construction of adjacent formwork or wall formwork may commence. Concrete for foundation sections shall not be placed until a minimum of 7 days have elapsed from the end of the adjacent placement. Concrete for walls above foundations may be placed after a minimum of 72 hours have elapsed, provided the footings have attained at least 50% of their design strength as demonstrated by testing of concrete cylinders.

B. Walls

Concrete for walls may be placed on top of foundations as described in Paragraph 3.05A herein. Concrete for subsequent wall placements located vertically above new walls may be placed after a minimum of 72 hours have elapsed, provided the walls have attained at least 50% of their design strength as demonstrated by testing of concrete cylinders. Concrete for wall sections shall not be placed until a minimum of 7 days have elapsed from the end of the adjacent placement.

C. Roof Slabs, Decks, and Walkways

Concrete for roof slabs, decks, and walkways may be placed on top of walls after a minimum of 72 hours have elapsed, provided slabs, decks, and walkways are supported by formwork. Concrete for slab, deck, and walkway sections shall not be placed until a minimum of 7 days have elapsed from the end of the adjacent placement.

3.06 Tamping and Vibrating

- A. As concrete is placed in the forms or in excavations, Contractor shall insure it is thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be high speed power vibrators (8000 to 10,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required.
- B. Contractor shall take care in placing concrete around waterstops. Contractor shall carefully work concrete by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration, over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.
- C. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be inserted vertically into the concrete and pulled out slowly, penetrating 1/3 of the layer depth of the layer previously placed. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified within 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.07 Finishing Concrete Surfaces

A. General

Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions shown are defined as tolerances and are specified in Paragraphs 1.04F and 1.04G herein. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.

B. Edges

All exposed edges of columns, beams, walls, roof slabs, elevated walkways, and foundations shall have a 3/4" chamfer, unless noted otherwise.

C. Formed Surfaces

Upon removal of forms, all surfaces shall be cured in accordance with Paragraph 3.09 herein. After the curing period, all surfaces shall be sandblasted to expose air pocket voids and surface defects, and then repaired in accordance with Paragraph 3.12 herein. After repairs are completed, surfaces shall be given an architectural finish in accordance with Paragraph 3.08 herein.

D. Unformed Surfaces

After proper and adequate vibration and tamping, all unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools. The classes of finish specified for unformed concrete surfaces are designated and defined as follows:

1. Class "1". After the floated surface (as specified for Class "3") has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks. The finish shall be smooth and free of all irregularities.
2. Class "2". Steel trowel finish (as specified for Class "1") without local depressions or high points. In addition, the surface shall be given a light hairbroom finish with brooming perpendicular to drainage unless otherwise shown. The resulting surface shall be rough enough to provide a nonskid finish.
3. Class "3". After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Contractor shall not excessively float concrete surfaces while the concrete is plastic or dust concrete surfaces with dry cement and sand to absorb excess moisture. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. Surface irregularities

shall not exceed 1/4". Joints and edges shall be tooled where shown or as determined by the Engineer.

4. Class "4". Contractor shall provide sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8". No further special finish is required.

Contractor shall finish unformed surfaces according to the following schedule unless otherwise shown or specified:

Unformed Surface Finish Schedule

<u>Area</u>	<u>Finish</u>
Grade slabs and foundations to be covered with concrete or fill material	Class "4"
Floors to be covered with grouted tile or topping grout	Class "3"
Slabs which are water bearing with slopes 10 percent and less	Class "1"
Sloping slabs which are water bearing with slopes greater than 10 percent	Class "2"
Slabs not water bearing	Class "2"
Slabs to be covered with built-up roofing	Class "3"
Interior slabs and floors to receive architectural finish/flooring	Class "3"

3.08 Architectural Finish

A. Smooth Sacked Finish

Contractor shall provide architectural finish for exposed to view concrete surfaces. Exposed concrete surfaces include the exterior of structures beginning 1' below grade, the tops of walls, and the interior of water holding structures from the floor to the top of the walls. Architectural finish shall also be provided for interior exposed to view concrete surfaces. All other incidental exposed to view concrete surfaces shall be provided with an architectural finish such as concrete stairways, concrete containment facilities around chemical storage tanks, elevated walkways, and the like. Architectural finish (i.e., smooth sacked finish) shall also be provided where shown.

B. Immediately after the forms have been stripped, the concrete surface shall be inspected by Engineer and treated and cured in accordance with in Paragraphs 3.09 and 3.12 herein.

C. After the concrete has cured at least 14 days, Contractor shall sandblast the surfaces and repair same in accordance with Paragraph 3.12 herein. Thereafter, the surfaces shall be wetted, and a grout shall be applied with a brush. The grout shall be made by mixing one

part portland cement and one part of fine sand that will pass a No. 16 sieve with sufficient water to give it the consistency of thick paint. The cement used in said grout shall be 1/2 gray and 1/2 white portland cement, as determined by the Engineer. White portland cement shall be Atlas white, or equal, furnished by the Contractor. The freshly applied grout shall be vigorously rubbed into the concrete surface with a wood float filling all small air holes. After all the surface grout had been removed with a steel trowel, the surface shall be allowed to dry and, when dry, shall be vigorously rubbed with burlap to remove completely all surface grout so that there is no visible paint-like film of grout on the concrete. The entire cleaning operation for any area shall be completed the day it is started, and grout shall not be left on the surface overnight.

D. Surface Overnight

Cleaning operations for any given day shall be terminated at panel joints. Contractor shall insure that the various operations be carefully timed to secure the desired effect which is a light-colored concrete surface of uniform color and texture without any appearance of a paint or grout film.

E. In the event that improper manipulation results in an inferior finish, Contractor shall rub such inferior areas with carborundum bricks.

F. Before beginning any of the final treatment on exposed surfaces, Contractor shall treat in a satisfactory manner a trial area of at least 200 square feet in some inconspicuous place selected by the Engineer and shall preserve said trial area undisturbed until the completion of the job.

G. All architecturally-treated concrete surfaces shall conform to the accepted sample in texture, color, and quality. It shall be the Contractor's responsibility to maintain and protect the concrete finish.

3.09 Curing and Dampproofing

A. General

All concrete shall be cured for not less than 14 days after placing in accordance with the methods specified herein for the different parts of the work as follows:

<u>Surface to be Cured or Dampproofed</u>	<u>Method</u>
Unstripped forms	1
Wall sections with forms removed	4
Construction joints between footings and walls, and between floor slab and columns	2
Encasement concrete and thrust blocks	3
All concrete surfaces not specifically provided for elsewhere in this Paragraph	4

<u>Surface to be Cured or Dampproofed</u>	<u>Method</u>
Floor slabs on grade in hydraulic structures	5
Roof and slabs not on grade	6

B. Method 1

Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removed. If steel forms are used the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms are removed within 14 days of placing the concrete, curing shall be continued in accordance with Method 4, Paragraph 3.09E herein.

C. Method 2

The surface shall be covered with burlap mats which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.

D. Method 3

The surface shall be covered with moist earth not less than 4 hours, nor more than 24 hours, after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least 7 days after placement of concrete.

E. Method 4

The surface shall be sprayed with a liquid curing compound.

1. Curing compound shall be applied in accordance with the manufacturer's printed instructions at a maximum coverage rate of 175 square feet per gallon and in such a manner as to cover the surface with a uniform film which will seal thoroughly. Two spray coats shall be applied, with the second coat sprayed at right angle direction from first coat.
2. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, Contractor shall repair break immediately by the application of additional curing compound over the damaged portion.
3. Wherever curing compound may have been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, said compound shall be entirely removed by wet sandblasting just prior to the placing of new concrete.
4. Where curing compound is specified, it shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within

2 hours after removal of forms from contact with formed surfaces. Repairs required to be made to formed surfaces shall be made within the said 2-hour period; provided, however, that any such repairs which cannot be made within the said 2-hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound, following which repairs shall be made as specified herein.

F. Method 5

Immediately after the concrete has been screeded, it shall be treated with a liquid evaporation retardant. The retardant shall be used again after each work operation as necessary to prevent drying shrinkage cracks.

1. Immediately after each square foot of the concrete has been finished, it shall be given a coat of curing compound in accordance with Method 4, Paragraph 3.09E herein. Not less than one hour nor more than 4 hours after the coat of curing compound has been applied, the surface shall be wetted with water delivered through a fog nozzle, and concrete-curing blankets shall be placed on the slabs. The curing blankets shall be polyethylene sheet, polyethylene-coated waterproof paper sheeting or polyethylene-coated burlap. The blankets shall be laid with the edges butted together and with the joints between strips sealed with 2" wide strips of sealing tape or with edges lapped not less than 3" and fastened together with a waterproof cement to form a continuous watertight joint.
2. Curing blankets shall be left in place during the 14 day curing period and shall not be removed until after concrete for adjacent work has been placed. Should the curing blankets become torn or otherwise ineffective, Contractor shall replace damaged sections. During the first 3 days of the curing period, Contractor shall not allow traffic of any nature or depositing, temporary or otherwise, of any materials on the curing blankets. During the remainder of the curing period, foot traffic and temporary depositing of materials that impose light pressure will be permitted only on top of plywood sheets 5/8" minimum thickness, laid over the curing blanket. Contractor shall add water under the curing blanket as often as necessary to maintain damp concrete surfaces at all times.

G. Method 6

Concrete slabs shall be treated with an evaporation retardant as specified in Method 5. The concrete shall be kept continuously wet by the application of water for a minimum period of at least 14 consecutive days beginning immediately after the concrete has been placed or forms removed. Heavy curing mats shall be used as a curing medium to retain the moisture during the curing period. The curing medium shall be weighted or otherwise held in place to prevent being dislodged by wind or any other causes. Until the concrete surface is covered with the curing medium, the entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed. Curing blankets and concrete shall be kept continuously wet by the use of sprinklers or other means both during and after normal working hours. Immediately after the application of water has terminated at the end of the curing period,

the curing medium shall be removed and curing compound immediately applied in accordance with Method 4, Paragraph 3.09E herein. Contractor shall dispose of excess water from the curing operation to avoid damage to the work.

3.10 Protection

Contractor shall protect all concrete against injury until final acceptance by the Owner. Fresh concrete shall be protected from damage due to rain, hail, sleet, or snow. Contractor shall provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring. Immediately following the first frost in the fall, Contractor shall be prepared to protect all concrete against freezing. After the first frost, and until the mean daily temperature in the vicinity of the worksite falls below 40°F for more than one day, the concrete shall be maintained at a temperature not lower than 50°F for at least 72 hours after it is placed.

3.11 Curing in Cold Weather

- A. Water curing of concrete may be reduced to 6 days during periods when the mean daily temperature in the vicinity of the worksite is less than 40°F; provided that, during the prescribed period of water curing, when temperatures are such that concrete surfaces may freeze, water curing shall be temporarily discontinued.
- B. Concrete cured by an application of curing compound will require no additional protection from freezing if the protection at 50°F for 72 hours is obtained by means of approved insulation in contact with the forms or concrete surfaces; otherwise, concrete shall be protected against freezing temperatures for 72 hours immediately following 72 hours protection at 50°F. Concrete cured by water curing shall be protected against freezing temperatures for 3 days immediately following the 72 hours of protection at 50°F.
- C. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40°F in 24 hours. In the spring, when the mean daily temperature rises above 40°F for more than 3 successive days, the specified 72 hour protection at a temperature not lower than 50°F may be discontinued for as long as the mean daily temperature remains above 40°F; provided, that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.
- D. Where artificial heat is employed, Contractor shall take special care to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound; provided, that the use of curing compound for such surfaces is otherwise permitted by these specifications.

3.12 Treatment of Surface Defects

- A. As soon as forms are removed, all exposed surfaces shall be carefully examined by Engineer and any irregularities shall be immediately rubbed or ground by the Contractor in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Contractor shall not plaster or coat surfaces to be smoothed. Concrete shall then be

cured for the specified curing period in accordance with Paragraph 3.09 herein. After the curing period, all surfaces shall be sandblasted to remove curing compound (if utilized), concrete paste film, and laitance, and to expose all air pocket voids and surface defects. Repairs shall not be made until after inspection by the Engineer. Contractor shall not in any case perform extensive patching of honeycombed concrete. Concrete containing minor voids, holes, or similar depression defects with a maximum depth of 1/4" may be filled with the grout used for the architectural finish, or if below grade on the exterior, may be left unfilled. Concrete containing minor voids, holes, honeycombing, or similar depression defects deeper than 1/4" with a maximum depth of 3/4" and/or a maximum surface area of 2 square inches shall be repaired as specified in Section 3.12B. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be repaired utilizing a repair material specifically manufactured for such use (such as Sikatop 121) subject to approval by Engineer, or completely removed and replaced. All repairs and replacements herein specified shall be promptly executed by the Contractor at its own expense.

- B. Defective surfaces to be repaired as specified in Paragraph 3.12A herein, shall be cut back from true line a minimum depth of 1/2" over the entire area. Edges shall not be feathered. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than 1/32" depth of the surface film from all hard portions, by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of applying cement mortar so that while the repair material is being applied, the surfaces under repair will remain moist, but not so wet as to overcome the suction upon which a good bond depends. The concrete shall then be patched as follows:

A bonding material such as acryl 60 shall be applied to the surface of the area to be repaired just prior to application of the repair mixture. The repair mixture shall consist of one part of Type II, low alkali, portland cement to 3 parts concrete sand. Mix solution shall contain 1/3 bonder, such as acryl 60, to 2/3 water and added in quantities sufficient to allow placement but not cause hairchecking or slippage. Quantities prepared should be limited to that able to be completed within 30 minutes. Areas repaired shall be compacted with a wood ramming device and cured with the water/acryl 60 solution. Repair mixture shall be applied in maximum 1" lifts.

For exposed walls, the cement shall contain such a proportion of Atlas white portland cement as is required to make the color of the patch match the color of the surrounding concrete.

- C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired as described in Paragraph 3.12B herein.
- D. All repairs shall be built up and shaped in such a manner that the completed work will conform to the requirements of Paragraph 3.08 or 3.09 herein, as applicable, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures.

3.13 Joint Sealant in Hydraulic Structures

Joint sealant shall be placed in all horizontal and vertical joints of all cast-in-place walls exposed to water. Provide 1" wide x 1/2" deep formed groove for joint sealant. Sealant strip material and installation procedure shall be per Paragraph 2.05 herein.

3.14 Installation of Epoxy Rebar Dowels and Anchor Bolts

Epoxy rebar dowels and anchor bolts shall be bonded with the Hilti Hit-RE 500-SD System, or equal. Unless noted otherwise, rebar dowels shall be ASTM A615 Grade 60 steel and anchor bolts shall be 316 stainless steel threaded rod. Rebar dowels and anchor bolts shall be installed to the depths shown on the Drawings or equipment manufacturer's shop drawings. Prior to injecting epoxy, each drilled hole shall be cleaned out with a nylon brush. Contractor shall install dowels and anchor bolts in strict accordance with the manufacturer's printed instructions.

3.15 Backfilling Against Concrete Structures

All curing shall be in accordance with Paragraph 3.09 herein.

A. Foundations

Minimum time to begin backfilling against foundations is 72 hours from completion of placement.

B. Walls

For non-hydraulic structures, backfilling may commence after 7 days and 75% of design strength have been reached, as demonstrated by testing of field cured concrete cylinders. Backfill height shall not exceed one half of wall height until wall has attained 100% of design strength. Hydraulic structures shall not be backfilled until after hydrostatic leak testing has been completed and accepted.

C. Shear Rings and Thrust Blocks

Shear rings and thrust blocks shall be cured 24 hours minimum prior to backfilling. No pipeline pressure testing shall be performed until 7 days after the last concrete placement.

3.16 Testing of Hydraulic Structures

A. General

Contractor shall water test all concrete tanks, hydraulic channels, sumps, basins, and other structures designed to contain water prior to backfilling. Testing shall be accomplished by filling the structure with water. Testing shall not be performed until roof is in place (if applicable) and all concrete has attained full design strength. Contractor shall provide the following:

1. All pumps, power, piping, and any other equipment required to fill tanks for testing.

2. Necessary provisions to dispose of test water after testing, including pumping if necessary. At completion of tests all temporary piping and connections shall be removed. Waste water shall be disposed of without creating a nuisance or damage to adjacent property.

B. Test Procedure

The structure shall be full to high water level at beginning of test. Contractor may elect to keep the tank full of water for as long as 48 hours prior to the test to allow for water absorption by the concrete. Test period shall be 5 consecutive 24 hour periods totaling 5 consecutive days. Liquid level shall be accurately measured at the beginning and end of test to determine amount of leakage. All visible leaks shall be marked for repair after draining. Permissible leakage from the structure shall not exceed 0.5 gpm per million gallon storage capacity in each 24 hour period over a period of 5 consecutive days after allowance is made for evaporation. If the leakage exceeds the permissible amount, the structure shall be emptied, leaks shall be repaired (in a manner acceptable to the Engineer), and the test rerun. Even if structure passes water loss test, all visible leaks shall be repaired and the test rerun to demonstrate all visible leaks have been repaired.

C. Leak Repair

All visible leaks shall be repaired from the structure interior utilizing epoxy injection. The hydraulic structure shall be drained, and a surface seal shall be applied to the area where leak commences; thereafter, the crack(s) shall be injected with epoxy in accordance with the manufacturer's recommendations. After injection process is completed, the structure shall be refilled and checked for visible leakage. If structure continues to leak, this process shall be repeated until no visible leaks are present.

3.17 Care and Repair of Concrete

Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance of the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, fails to conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the Contractor's expense.

END OF SECTION

SECTION 04200
BASIC CONCRETE MASONRY SPECIFICATIONS

PART 1 - GENERAL

1.01 General Requirements

- A. Contractor shall furnish all labor, material, and equipment and perform all operations necessary to execute all concrete masonry construction as required in the Contract Documents.
- B. Contractor shall make all preparations and do all work necessary to receive and adjoin other work.
- C. Contractor shall give the work his personal supervision and shall keep a competent foreman on the job at all times.
- D. Contractor shall inspect and verify position of all dowels required for masonry on other construction including foundations.
- E. Contractor shall arrange necessary storage space for construction materials at the job site.
- F. Contractor shall call for all inspections required in the course of his work.

1.02 Reference Codes, Specifications, and Standards

A. Codes

Whenever reference is made herein to Building Code, it shall mean the California Building Code (CBC), latest edition, of the California Building Standards Commission.

B. Specifications

Whenever reference is made herein to Standard Specifications, it shall mean the Standard Specifications for Public Works Construction, latest edition, as published by Building News Incorporated of Los Angeles, California.

C. Commercial Standards

Whenever reference is made herein to ASTM, it shall mean the Annual Book of ASTM Standards, latest edition, as published by the American Society for Testing and Materials.

1.03 Contractor Submittals

All submittals shall be in accordance with the Contractor Submittals Technical Specifications, Section 01300.

A. Certification

Concrete block manufacturer shall provide certified data demonstrating that the masonry units to be furnished will meet or exceed the requirements of this specification.

B. Samples

Prior to commencing with work, Contractor shall submit samples of the block units for Owner's approval of type and color.

C. Mix Designs

Prior to beginning the work, Contractor shall submit to Owner, for approval, proposed grout and mortar mix designs which shall show the proportions and gradations of all materials proposed for each mix to be used on the job. The mix designs shall be designed by an independent testing laboratory acceptable to Owner. All costs related to such mix designs shall be borne by the Contractor.

1.04 Quality Assurance

A. All concrete masonry shall comply with the Building Code and reference material published by the Masonry Institute of America.

B. Sample Panel

Contractor shall build a sample panel, approximately 4 feet by 6 feet, for review and approval by Owner before any masonry construction is performed. Said sample panel may be part of the project and incorporated into the wall system. Full size concrete masonry units which have been selected and approved by the Owner to show color range, maximum texture range, bond, mortar, tooling of joints, and quality of workmanship shall be used in the sample panel. Sample panel shall remain on the project for comparison purposes with the actual masonry work.

If the sample panel is not part of the wall system, it shall be demolished and removed from the site after completion and acceptance for the project concrete masonry work, unless Contractor is directed otherwise by Owner.

C. Certified Delivery Tickets

Where ready-mix grout is used, Contractor shall provide certified delivery tickets at the time of delivery of each load of grout. Each certificate shall show the total quantities (by weight) of cement, sand, each class of aggregate, and admixtures, and the amounts of water (by gallons) in the aggregate and added at the batching plant as well as the amount of water allowed to be added at the site for the specific design mix. Each certificate shall, in addition, state the mix number, total yield in cubic yards, and the time of day, to

the nearest minute, corresponding to when the batch was dispatched, when it left the plant, when it arrived at the job, the time that unloading began, and the time that unloading was finished.

D. Testing of Grout

1. Test Specimens and Samples

- a. Contractor shall take field samples on the first day of masonry construction, at any change in materials during construction, and whenever, in the judgment of the Owner, tests are necessary to determine the quality of the materials.
- b. Contractor shall prepare three grout specimens per sample. Each grout specimen shall be a square prism, nominally 3 inches or larger on the sides and twice as high as the width.

2. Procedures

- a. Contractor shall construct samples in the presence of the Owner or his representative. The same personnel who lays the block in the structure shall construct the grout specimens.
- b. Contractor shall prepare each specimen in a mold consisting of masonry units proposed for construction with the same moisture condition as those being laid. The units shall form a space with dimensions of 3-5/8 inches by 3-5/8 inches by 7-5/8 inches. The space shall be lined with a permeable paper (such as a paper towel) or porous separator to prevent bonding to the masonry units, but still allowing the excess water to be absorbed.

Contractor shall place a representative sample of the grout into the molds, puddle, and keep damp and undisturbed for 48 hours. After 48 hours, Owner's Representative will transport the specimens to a test laboratory for storage.

E. Testing of Mortar

1. Test Specimens and Samples

- a. Contractor shall take field samples on the first day of masonry construction, at any change in materials during construction, and whenever, in the judgment of the Owner, tests are necessary to determine the quality of the materials.
- b. Contractor shall prepare three mortar specimens per sample. After 48 hours, Owner's Representative will transport the specimens to a test laboratory for storage.

1.05 Product Storage

Contractor shall store and protect all materials as follows:

A. Masonry Units

Masonry units shall be carefully stacked prior to use and shall be properly protected from weather by cover or inside storage. All units shall be handled with reasonable care to prevent marring or damaging of faces, edges, and corners of units. All marred or damaged units shall be discarded.

B. Lime and Cement

Lime and cement shall be delivered in original packages and stored on platforms above ground, protected against moisture.

C. Aggregates

Aggregates shall be stored on platforms so as to exclude dirt.

D. Reinforcing Steel

Reinforcing steel shall be stored above ground to prevent bending or rusting.

PART 2 - PRODUCTS

2.01 Materials

All products shall conform to the following requirements:

A. Concrete Masonry Units

1. Masonry units shall be hollow load-bearing concrete masonry, Grade N, Type I units conforming to ASTM C90, latest, and manufactured in accordance with requirements of the Concrete Masonry Association Specifications.
2. Masonry units shall have maximum shrinkage of .08 of 1% from the saturated to the oven dry condition.
3. Unless specified otherwise on the Drawings, masonry units shall be medium-weight units (105 to 125 lb/cubic foot) manufactured by a member of the Concrete Masonry Association. Masonry units may be high temperature steam cured. Owner shall select color of masonry units.

B. Cement

1. Cement for mortar shall be Type I, II, or III Portland cement conforming to ASTM C150, latest.

2. Air-Entrained Portland Cement for mortar shall be Type I-A, II-A, or III-A conforming to ASTM C175, latest. (Note: When using air-entrained cements, mortar shall not contain more than 1/10 part lime putty.)
3. Plastic cement shall have less than 12% total volume in approved plasticizing agents and shall conform to all of the requirements for Portland cement in ASTM C150, latest, except with respect to limitations on insoluble residue, air-entrained, and additions subsequent to calcination.

C. Aggregate

1. Aggregate shall be clean, sharp, and well graded, and free from injurious quantities of dust, lumps, shale, alkali, surface coatings, and organic matter.
2. Sand shall conform to ASTM C144, latest.
3. Pea gravel shall be graded with 100% passing the 3/8 inch sieve and not more than 5% passing the No. 8 sieve.

D. Lime Putty

1. Lime putty shall be made from approved hydrated lime or quicklime and shall weigh not less than 83 pounds per cubic foot.
2. Hydrated lime shall conform to ASTM C207, latest.
3. Quicklime shall conform to ASTM C5, latest. Quicklime shall be slaked and then screened through a 16-mesh sieve. After slaking, screening, and before using, it shall be stored and protected for minimum 10 days.

E. Admixtures

Admixtures shall not be used in mortar or grout unless specifically approved by Engineer.

F. Reinforcing Steel

1. Reinforcing steel shall be Grade 60 deformed bars conforming to ASTM A615, latest, except that 1/4 inch ties may be plain bars.
2. Reinforcing steel shall be clean and free from loose rust, scale, and dirt, and coatings that reduce bond.

2.02 Mortar and Grout

A. Mortar

Mortar shall be freshly prepared and uniformly mixed in ratio 1 part portland cement, 1/4 part lime putty, and 3-1/2 parts sand. Mortar shall be Type S with a minimum compressive strength of 1,800 psi at 28 days, conforming to ASTM C270, latest.

B. Grout

1. Grout shall have minimum compressive strength of 2,000 psi at 28 days.
2. Grout shall be of fluid consistency and mixed in ratio 1 part cement, 3 parts sand for grout spaces less than 4 inches in any dimension. Grout shall be of fluid consistency and mixed in ratio 1 part cement, 2 parts sand, and 2 parts pea gravel for grout spaces greater than 4 inches.
3. Fluid consistency shall mean that consistency of fluid shall be enough for pouring and yet not so fluid that the constituent parts of the grout separate when grout is poured (slump equals 9 inches + 1 inch).

PART 3 - EXECUTION

3.01 Workmanship

- A. Masonry work shall be started only when horizontal and vertical alignment of foundation is within 1 inch of plumb or line.
- B. Contractor shall prevent grout and mortar stains. Contractor shall keep wall continually clean. If grout runs over, Contractor shall clean wall immediately.
- C. All masonry shall be laid true, level and plumb in accordance with the Construction Drawings.
- D. Contractor shall cut all masonry units accurately to fit all openings, conduit, ducts, and plumbing. All holes shall be neatly patched.
- E. Construction support shall not be attached to the wall except where specifically permitted by the Engineer.
- F. The top surface of the concrete foundation shall be clean and free of laitance and the aggregate exposed by sandblasting prior to starting masonry construction.
- G. Where no bond pattern is shown, walls shall be laid up in straight, uniform courses with regular half or running bond.
- H. All work, bond patterns, or special details shown on the Construction Drawings shall be accurately and uniformly executed.

3.02 Protection of the Work

- A. Contractor shall protect all sills, ledges, and offsets from mortar droppings or other damage during construction.
- B. Contractor shall prevent visible mortar and grout stains on the exterior of the work. Contractor shall remove stains immediately if they occur.

3.03 Masonry Units

- A. All masonry units shall be sound, free of cracks, or other defects that would interfere with the proper placing of the unit or impair the strength of construction.
- B. All masonry units shall be stored on the job so that they are kept off the ground and protected from the elements. Wetting of units is not permitted.
- C. Proper masonry units shall be used to provide for all windows, doors, bond beams, lintels, pilasters, and knockouts, with a minimum unit cutting.
- D. Where masonry unit cutting is necessary, Contractor shall utilize a masonry saw making all cuts neat and true.

3.04 Joints

- A. Starting joints on foundations shall be laid with full mortar coverage on the bed joints except that the area where grout occurs shall be free from mortar so that the grout will be in contact with the foundation.
- B. Mortar joints shall be straight, clean, and uniform in thickness and shall be tooled as specified.
- C. Contractor shall tool exposed wall joints with a round bar (or V-shaped bar) 2 feet long to produce a dense, slightly concave surface well bonded to the block at the edges.
- D. Tooling shall be done when the mortar is partially set but sufficiently plastic to bond. All tooling shall be done with a tool which compacts the mortar, pressing the excess mortar out of the joint rather than dragging it out.
- E. Where walls are to receive plaster, Contractor shall strike joints flush.
- F. Where joints are to be concealed under paint, Contractor shall fill joints flush and then sack to produce a dense surface without sheen.
- G. Unless otherwise specified, horizontal and vertical mortar joints shall be 3/8 inch thick with full mortar coverage on the face shells and on the webs surrounding cells to be filled.
- H. Vertical head joints shall be buttered well for a thickness equal to the face shell of the block and these joints shall be shoved tightly so that the mortar bonds well to both blocks. Joints shall be solidly filled from the face of the block to the depth of the face shell.
- I. If it is necessary to move a block so as to open a joint, Contractor shall remove block from wall and set in fresh mortar.
- J. Intersecting masonry walls and partitions shall be bonded by the use of steel ties at 24 inch centers maximum.

- K. Where stack bond is specified, approved metal ties shall be provided horizontally at 24 inch centers maximum.

3.05 Reinforcing

- A. When a foundation dowel does not line up with a vertical core, it shall not be sloped at more than one horizontal to six vertical. Dowels shall be grouted into a core in vertical alignment even though it is in an adjacent cell to the vertical wall reinforcing.
- B. Reinforcing bars shall be straight except for bends around corners or where bends or hooks are detailed on the Drawings.
- C. Reinforcing steel where spliced shall be lapped a minimum of 40 bar diameters.
- D. When full length vertical bars are used, they shall be held in position at top and bottom at intervals not exceeding 48 inches along the reinforcement.
- E. Horizontal reinforcing shall be laid on the webs of bond beam units and shall be solidly grouted in place. Reinforcing in channel units shall be spaced off the bottom of the unit.
- F. Vertical reinforcing shall have a minimum clearance of 1/2 inch from the masonry.
- G. Wire reinforcement shall be completely imbedded in mortar or grout. Mortar joints with wire reinforcement shall be at least twice the thickness of the wire.
- H. Wire reinforcement shall be lapped at least 8 inches at splices and shall contain at least 1 cross wire at each piece of reinforcement in the lap distance.

3.06 Grouting

- A. Reinforcing steel shall be in place and inspected by Engineer before grouting starts.
- B. Unless specified otherwise on drawings, all walls shall be solid grouted. Unless specifically allowed on drawings, height of grout pours shall not exceed 4 feet. All debris and projecting mortar shall be cleaned out before pouring grout. Pours shall be stopped 1-1/2 inches below the top of a course to form a key at pour joints.
- C. Contractor shall consolidate grout by mechanical vibration during placement before loss of plasticity in a manner to fill the grout space. Grout pours greater than 12 inches shall be reconsolidated by mechanical vibration after 3 to 5 minutes to minimize voids due to water loss. Grout pours 12 inches or less in height shall be mechanically vibrated or puddled.
- D. Vertical cells to be filled shall have vertical alignment to maintain a continuous unobstructed cell area not less than 2 inches by 3 inches.
- E. When higher pours are specified, grout lifts shall not exceed 8 feet. A cleanout hole shall be provided at the bottom of each cell to be poured.
- F. Contractor shall grout beams over openings in a continuous operation.

- G. Contractor shall cover the tops of unfilled cell columns under a horizontal masonry beam with metal lath, or special units shall be used to confine the grout fill to the beam section.
- H. Contractor shall install all bolts, anchors, and similar wall inserts prior to grouting and solidly grout them in place.

3.07 Tolerances

- A. Maximum Variation from Unit to Adjacent Unit: 1/16 inch.
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 feet or more.
- C. Maximum Variation from Plumb: 1/4 inch non-cumulative; 1/2 inch.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 feet and 1/4 inch in 10 feet; 1/2 inch in 30 feet.
- E. Maximum Variation of Joint Thickness: 1/8 inch in 3 feet.

3.08 Cleaning and Protection

- A. Masonry walls are to be left bare or unpainted unless otherwise specified; Contractor shall prevent mortar splashes.
- B. Construction supports shall not be attached to the wall except where specifically permitted by Engineer.
- C. All forms shall be made tight (special attention is necessary for bottom form of block bond beams) and concrete and grout spilled on the wall shall be washed off immediately.
- D. Walls shall have their surfaces dampened for three days with a light fog spray during the mortar curing period. They shall not be saturated with water for curing or any other purposes.
- E. At the conclusion of work, Contractor shall clean down all masonry walls, remove his scaffolding and equipment used in the work, clean up all debris, refuse, and surplus material, and remove them from the premises.
- F. After a minimum of 30 days have passed but no longer than 60 days after completing all work, Contractor shall remove all efflorescence that has leached onto the walls from the grout and mortar.
- G. After all efflorescence has been removed, Contractor shall seal walls with one coat of water repellent clear sealant in strict accordance with the manufacturer's installation procedures as approved by the Engineer.

END OF SECTION

SECTION 05100
BASIC STRUCTURAL STEEL
AND MISCELLANEOUS METAL WORK SPECIFICATIONS

PART 1 - GENERAL

1.01 General Requirements

Contractor shall furnish all labor, equipment, and material and perform all operations necessary for fabrication, construction, and installation of structural and miscellaneous metal specified.

Where miscellaneous metal and equipment items are required to fit spaces previously constructed, measurements for the fabrication of such items shall be made at the site so that items fit as required. Standard commercial products which meet general requirements, and vary only in nonessential detail, will be acceptable, subject to Owner's approval.

All work shall be executed and finished in accordance with approved shop drawings and conform with the best practice required to produce the highest grade construction. Contractor shall be solely responsible for errors of fabrication and correct fitting of structural members shown on the shop drawings.

1.02 Quality Assurance

Unless otherwise specified, all work specified in the Contract Documents shall comply with requirements of the following specifications and codes:

A. Steel Work

Fabrication and erection of structural steel shall be in accordance with AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," and "Code of Standard Practice for Steel Buildings and Bridges", latest editions.

B. Aluminum Work

Fabrication and erection of aluminum shall be in accordance with the applicable requirements of Chapter 28 of the Uniform Building Code, latest edition, and herein referenced standards of the Aluminum Association.

C. Welding Inspection

All welding of structural steel assemblies shall be performed under continuous inspection of a "Special Inspector" selected by the Owner. Should such fabrication be performed in the shop of a licensed fabricator approved by the governing Building Official, only the field welding of structural steel assemblies will be required to be performed under continuous inspection of the "Special Inspector". Contractor shall notify inspector at least 24 hours in advance of needed inspections. Contractor shall provide copies of Inspection Reports for Owner.

1.03 Submittals

All submittals shall be in accordance with Specification Section 01300.

A. Shop Drawings

Contractor shall submit shop drawings for approval before fabrication of any of the work. Shop drawings shall show complete fabrication details with material lists, including all welds, fabrication and finish details, and shop painting. In approved shop drawings, the Owner does not assume responsibility for accuracy of the work relative to other components as constructed. Also refer to applicable requirements hereafter specified in paragraph "Substitutions". All dimensions shall be field verified by the Contractor prior to fabrication.

B. Test Reports

Contractor shall furnish notarized certified physical and chemical mill test reports for material used for major structural members. All tests shall be performed in accordance with applicable ASTM Standards.

C. Shop Painting Data

In coordinated manner with requirements for Painting and Protective Coatings, Contractor shall submit product list with product data sheets of intended shop coats which, for compatibility, shall be the same products and manufacturer as those field-applied systems specified in the Basic Coating and Painting Specification for Water and Wastewater Facilities.

PART 2 - PRODUCTS

2.01 Materials - General

Materials shall be new, sound, and shall comply with the following:

A. Steel

Rolled shapes, plates, and bars shall conform to AISC "Manual of Steel Construction" and ASTM Specification A-36, latest editions.

1. Stainless Steel

Unless otherwise designated or approved, Contractor shall use Type 316 stainless steel alloy conforming to ASTM A-167 and ASTM A-276, latest editions, for plates and bars.

2. Steel Pipe

Material shall conform to ASTM A-53, Grade B seamless galvanized as required, Schedule 40.

B. Cast Iron

Material shall conform to ASTM A-48, Class 30, except as specifically designated otherwise.

C. Ductile Iron

Material shall conform to ASTM A-536 using grade 60-40-18 or better, except as specifically designated otherwise.

D. Aluminum

1. All plate, pipe, and structural shapes shall be new and shall conform to ASTM B209 (Plate), B308 (Shapes), B429 (Pipe and Tubing), B211 (Bar Stock), and applicable Federal Specifications for 6061-T6 alloy, unless otherwise designated.
2. Aluminum pipe rail shall be of 6061-T6 alloy and be Schedule 40 or greater.
3. Alloys and tempers for various members where not otherwise designated, shall be as required for proper forming and fabrication to meet or exceed structural requirements, and shall be of alloys specially produced to best achieve specified color anodized finishes. Contractor shall provide supporting printed recommendations from parent aluminum producer. For sheet fabricated members Contractor shall use only homogenous aluminum products and no clad products.
4. Contingent upon alloys being welded, Contractor shall use only inert gas shielded arc or resistance welding process with filler alloys as specified in the UBC. Contractor shall not use any process requiring a welding flux.

E. Checkered Plate

Raised lugs shall be diamond shaped and have an angled and opposed pattern. Contractor shall use 6061-T6 alloy aluminum, except where steel is specified. Steel shall be of ASTM A36 carbon steel, hot dip galvanized.

F. Manhole Covers

Castings for manhole covers and frames shall be of tough gray iron free from cracks, holes, and swells, and of workmanlike finish. They shall conform to ASTM A-48, latest, Class 30, and shall be of the type specified.

G. Common Bolts

Except as otherwise designated or specified, bolts shall be standard commercial quality steel units conforming to ASTM A-307; galvanize where used with galvanized work.

H. High Strength Bolts & Studs

Except as otherwise designated or specified, bolts shall conform to ASTM A325; studs shall conform to ASTM A449; nuts shall conform to ASTM A194, 2H heavy hex; washers shall conform to ASTM F436. They shall be galvanized where specified or where used with galvanized steel.

I. Stainless Steel Bolts

Except as otherwise designated or specified, bolts, cap screws, and studs shall be Type 316L conforming to ASTM F-593; nuts shall conform to ASTM F-594.

J. Deferred Bolting Devices

Deferred bolting devices such as wedge anchors or epoxy anchors shall be used in lieu of cast-in-place anchor bolts only where specifically noted or detailed; they shall be installed in accordance with current I.C.B.O. Research Report Approval and shall consist of the following:

1. Wedge anchors shall be Red Head Trubolt Anchors, Hilti Anchors, or approved equal. Mechanical anchors such as wedge or expansion anchors shall not be used for anchorage of any vibrating machinery or equipment.
2. Epoxy anchors shall be Hilti Hit C-100, ITW/Ramset Epcon, or approved equal.

K. Galvanizing

1. Iron and Steel

Galvanizing shall conform to ASTM A123, with minimum weight per square foot of 1.25 ounces.

2. Ferrous Metal Hardware Items

Galvanizing shall conform to A153, with average coating weight of 1.25 ounces per square foot.

3. Touch-Up Material for Galvanized Coatings

Galvanized coatings marred or damaged during erection or fabrication shall be repaired by use of DRYGALV as manufactured by the American Solder and Flux Company, Galvalloy, Galvion, or equal, applied in accordance with the manufacturer's instructions.

L. Welding Electrodes

1. Steel Electrodes

Contractor shall use E70XXX rod for shielded metal arc welding conforming to AWS A5.1 or A5.5 and F7X-EXXX for submerged arc welding conforming to

AWS A5.17. For steel alloys other than ASTM A-36 and A-53, Contractor shall use electrodes recommended in writing by AWS and by the parent steel manufacturer.

2. Aluminum Electrodes

Contingent upon alloys being welded, Contractor shall use only inert gas shielded arc or resistant welding process with filler alloys conforming to U.B.C. Standard No. 28, Table 28-1-C. Contractor shall not use any process requiring a welding flux.

3. Stainless Steel Electrodes

Contractor shall weld stainless steel with electrodes and by techniques specified in pertinent AWS A5 Series Specification, and as recommended in Welded Austenitic Chromium-Nickel Stainless Steel Techniques and Properties as published by the International Nickel Company, Inc., New York, N.Y.

M. Shop Prime Paint

To assure compatibility with field-applied paint or coating systems, for ferrous metals other than stainless steel, galvanized steel, and cast iron, Contractor shall use same shop prime paint product and manufacturer as painting or protective coating system intended for field application specified in the Basic Coating and Painting Specification for Water and Wastewater Facilities. Contractor shall not shop prime portions of work immediately adjacent to intended field welds or portions intended for embedment in concrete.

N. Storage of Materials

Structural material, either plain or fabricated, shall be stored above ground upon platforms, skids, or other supports. Material shall be kept free from dirt, grease, and other foreign matter and shall be protected from corrosion.

PART 3 - EXECUTION

3.01 Fabrication

A. Workmanship shall conform to AISC specifications, latest edition. Work shall conform to the Contract Documents and approved shop drawings. Work shall be performed by Fabricator approved by governing Code Authorities. Aluminum work shall conform to the applicable requirements of "Specifications for Aluminum Structures, Aluminum Construction Manual" of the Aluminum Association, latest edition.

1. Shop connections shall be welded or bolted unless otherwise indicated.
2. Insofar as possible, Contractor shall fit and assemble all work in shop, ready for erection.

B. Members

1. All members shall be free from twists, kinks, buckles, or open joints.
2. All members, holes, and their spacing shall be so accurately made that, when assembled, the parts shall come together and bolt without distortion.
3. Parts assembled with bolts shall be in close contact, except where separators are required. Where unlike metals are in contact, Contractor shall insulate as necessary to prevent corrosion.
4. Bearing surfaces shall be planned to true beds. Abutting surfaces shall be closely fitted. Steel requiring accurate alignment shall be provided with slotted holes and/or washers for aligning the steel members.

C. Welding

1. Welding in shop and field shall be done by operators who have previously been qualified by tests, as prescribed in the American Welding Society, "Standards Qualifications Procedure". All welds shall exhibit characteristics required by AWS D1.0.
2. All welds shall be made with E70-XX classification mild or low-alloy steel covered arc-welding electrodes conforming to AWS A5.1 and A5.5 Specifications for filler metal, except as otherwise designated on Structural Drawings and except as otherwise recommended by AWS and AISC for welding high strength steel alloys other than ASTM A36 and A53 Steels.
3. All steel, before being fabricated, shall be thoroughly wire brushed, cleaned of all scale and rust, and thoroughly straightened by approved methods that will not injure the materials being used. Welding shall be continuous along the entire line of contact except where tack or intermittent welding is permitted by Engineer. Where exposed, welds shall be cleaned of flux and slag and ground smooth.
4. Welding of aluminum shall conform to the applicable requirements of Uniform Building Code, Chapter 28 and to the detail requirements of "Welding Aluminum" by the American Welding Society and the Aluminum Association.

3.02 Erection

- A. Erection shall include the installation and erection of all steel referred to in this Basic Specification. Contractor shall verify correctness before starting erection. Erection shall be performed in accordance with the latest edition of AISC Code of Standard Practice.
- B. As erection progresses, Contractor shall securely bolt up all members to take care of all dead-load, wind, and erection stresses.
- C. Contractor shall not perform final bolting or welding until each portion of the structure has been properly aligned and plumbed.

D. Contractor shall insure bolts are drawn up tight and threads set so that nuts cannot become loose.

E. Damaged Members

During erection, members which are bent, twisted, or damaged shall be straightened or replaced by Contractor as directed. If heating is required in straightening, heating shall be done in the presence of the inspector and a heating method shall be used which will ensure uniform temperature throughout the entire member. Members, which, in the opinion of the Owner, are damaged to an extent impairing their appearance, strength, or serviceability, shall be removed and replaced with new members by Contractor.

F. Anchor Bolts and Mounting Plates

Anchor bolts and mounting plates shall be properly located and built into connection work in accordance with the Contract Documents. Bolts and anchors shall be preset by the use of templates or such other methods as may be required to locate the anchors and anchor bolts accurately. Embedded anchor bolts that are submerged in process water or sludge, or are in enclosed tanks or spaces exposed to process gas or moisture, shall be Type 316 stainless steel with nuts of the same material. To such stainless steel bolts Contractor shall apply a non-oxidizing lubricant grease before bolting using a molybdenum disulphide grease compound or a NO-OX-10 type compound. Specialty anchoring systems shall be as specified or shown on Construction Drawings. Unless shown otherwise on the Drawings, all surface mounted plates, including base plates, shall be provided with 3/4" thick (minimum) non-shrink grout between the plate and concrete mounting surface.

G. Steel and Aluminum Pipe Rails and Railings

Pipe rail shall be painted steel or anodized aluminum as specified in Contract Documents. Steel and aluminum pipe rails and railings, complete with stanchions, toe plates, welded and bolted fittings, and attachments shall be fabricated true to size configurations and detail shown on Construction Drawings. Grind and polish welds flush and smooth. Curves, where indicated or necessary, shall be bent on a radius of not less than six (6) inches.

1. All pipe materials shall be Schedule 40 steel or aluminum.
2. If proprietary substitutions are proposed for railings and attachments, submittals shall be accompanied by acceptable test data by an independent testing laboratory showing that: the fitting and attachment will withstand the bending moment induced by a 200 lb. force applied at the top of the stanchion in any direction; and the railings will safely resist forces as required by Cal/OSHA and the Uniform Building Code. Test data shall be for attachments in similar materials as the field condition.
3. Safety chains shall be 5/16 inch carbon steel minimum grade 30 link chain with common swivel bolt harness type snap, all hot dip galvanized.

4. Contractor shall isolate aluminum from dissimilar metals and concrete for protection from galvanic deterioration. Aluminum shall be mill finished and free of damage and detracting appearance flaws. Contractor shall provide uniform AA-KA41 Architectural Class I clear anodic finish.
5. Contractor shall not provide attachments which require the post to be embedded in concrete or grout.

H. Bearing Plates

Contractor shall provide bearing plates under beams and columns resting on walls or footings. Bearing plates may be attached or loose and aligned on steel wedges or shims. After the supported members have been plumbed and properly positioned and the anchor nuts tightened, Contractor shall solidly dry-pack entire bearing area under the plate with approved bedding mortar. Wedges and shims shall be cut off flush with edge of bearing plate, and shall be left in place.

I. Substitutions

Unless otherwise directed, the exact sections, shapes, thicknesses, sizes, weights, and the details of construction shown for the structural steelwork shall be furnished as specified in the Contract Documents; however, Contractor, because of his stock or shop practices, may suggest substitutes if the net section area is not thereby reduced, if the section properties are at least equivalent, and if the overall dimensions are not exceeded. All substitutions or other deviations from Contract Drawings and/or Specifications shall be specifically noted or "clouded" on the shop drawing submittals.

J. Flame Cutting

Contractor shall not flame cut with a gas cutting torch in the field to correct fabrication errors on any major member in the structural framing. Contractor may flame-cut on minor members, when the member is not under stress, and then only following Owner's approval.

K. Dissimilar Metals

Contractor shall isolate aluminum from contact with dissimilar metals and materials, other than stainless steel, as follows:

1. Metals

Contractor shall apply on contact surfaces a heavy brush coat of approved zinc chromate primer made with a synthetic resin vehicle, followed by two brush coats of approved aluminum metal and masonry paint or a heavy coat of approved alkali-resistant bituminous paint. Alternatively, Contractor may separate surfaces with a non-absorptive tape or gasket.

2. Masonry, Concrete, or Plaster

Contractor shall apply a heavy brush coat of approved, alkali-resistant bituminous paint, or separate surfaces with non-absorptive tape or gasket.

3. Moisture-Absorbent Materials and Preservatively Treated Wood

Contractor shall paint such absorbent materials with two coats of approved aluminum house paint and protect aluminum contact surfaces with bituminous paint.

END OF SECTION

SECTION 07920
SEALANTS AND CAULKING
TECHNICAL SPECIFICATIONS

PART 1 - GENERAL

1.01 Summary

Throughout the Work, seal and caulk joints where shown on the Drawings and elsewhere as required to provide a positive barrier against passage of moisture and passage of air.

1.02 Submittals

- A. All submittals shall be in accordance with the Contractor Submittals Technical Specifications, Section 01300.
- B. Product data: Contractor shall submit complete information and technical data for all materials, including, but not limited to, the following:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
 - 3. Manufacturer's recommended installation procedures which, when approved by the Owner, will become the basis for accepting or rejecting actual installation procedures used on the Work.
- C. Samples: Upon request of the Owner, submit Samples of each sealant, each backing material, each primer, and each bond breaker proposed to be used.

1.03 Quality Assurance

Use adequate numbers of skilled workmen thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.

1.04 Delivery, Storage, and Handling

Do not keep sealants and caulking on the work site beyond the manufacturer's specified shelf life.

PART 2 - PRODUCTS

2.01 Sealants (as applicable)

- A. Provide the following sealants, or equals approved in advance by the Owner, where called for on the Drawings or otherwise required for a complete and proper installation.
1. Sealant Type A (at joints subjected to horizontal traffic):
 - a. Polyurethane, self-leveling, complying with ASTM C920, Grade P, Class 25.
 - b. Polyurethane, self-leveling, sealant shall be as manufactured by Sika Corporation, GE Sealants and Adhesives, Pecora Corporation, or product by equal manufacturer as approved by the Owner.
 2. Sealant Type B (at vertical joints and joints subject to extreme movement):
 - a. Polyurethane, non-sag, complying with ASTM C920, Type S, Grade NS, Class 25, use NT, M, A, and O.
 - b. Polyurethane, non-sag, sealant shall be as manufactured by Sika Corporation, GE Sealants and Adhesives, Pecora Corporation, or product by equal manufacturer as approved by the Owner.
 3. Sealant Type C (at joints not listed above):
 - a. Acrylic latex, complying with ASTM C834.
 - b. Acrylic latex sealant shall be as manufactured by GE Sealants and Adhesives, Pecora Corporation, or product by equal manufacturer as approved by the Owner.
- B. For other services, except as may be called for on the Drawings, provide products especially formulated for the proposed use and approved in advance by the Owner. The intent of this section of the work is for the Contractor and his subcontractor's to provide building and facility systems with the appropriate watertight and flexible sealant systems – no exceptions.
- C. Colors
1. Colors for each sealant installation will be selected by the Owner from standard colors normally available from the specified manufacturer.
 2. Should such standard color not be available from an approved substitute manufacturer except at additional charge, provide such colors at no additional cost to Owner.
 3. In concealed installations, and in partially or fully exposed installations where so approved by the Owner, use standard gray or black sealant.

2.02 Primers

Use only those primers which have been tested for durability on the surfaces to be sealed and are specifically recommended for this installation by the manufacturer of the sealant used.

2.03 Backup Materials

Use only those backup materials which are non-absorbent, non-staining, and specifically recommended for this installation by the manufacturer of the sealant used.

2.04 Masking Tape

For masking around joints, provide an appropriate masking tape which will effectively prevent application of sealant on surfaces not scheduled to receive it, and which is removable without damage to substrate.

2.05 Other Materials

Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Owner.

PART 3 - EXECUTION

3.01 Surface Conditions

Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 Preparation

A. Concrete and Ceramic Tile Surfaces

1. Install only on surfaces which are dry, sound, and well brushed, wiping free from dust.
2. At open joints, remove dust by mechanically blown compressed air if so required.
3. To remove oil and grease, use sandblasting or wire brushing.
4. Where surfaces have been treated, remove the surface treatment by sandblasting or wire brushing.
5. Remove laitance and mortar from joint cavities.

B. Steel Surfaces

1. Steel surfaces in contact with sealant:
 - a. Sandblast as required to achieve acceptable surface for bond.
 - b. If sandblasting is not practical, or would damage adjacent finish, scrape the metal or wire brush to remove mill scale and rust.
 - c. Use solvent to remove oil and grease, wiping the surfaces with clean white rags only.
2. Remove protective coatings on steel by sandblasting or by using a solvent which leaves no residue.

C. Aluminum Surfaces

1. Aluminum surfaces in contact with sealant:
 - a. Remove temporary protective coatings, dirt, oil, and grease.
 - b. When masking tape is used for protective cover, remove the tape just prior to applying the sealant.
2. Use only such solvents to remove protective coatings as are recommended for that purpose by the manufacturer of the aluminum work, and which are non-staining.

3.03 Installation of Backup Material

- A. When using backup of tube or rod stock, avoid lengthwise stretching of the material. Do not twist or braid hose or rod backup stock.

B. Installation Tool

1. For installation of backup material, provide a blunt-surfaced tool of wood or plastic, having shoulders designed to ride on the adjacent finished surface and a protrusion of the required dimensions to assure uniform depth of backup material below the sealant.
2. Do not, under any circumstance, use a screwdriver or similar tool for this purpose.
3. Using the approved tool, smoothly and uniformly place the backup material to the depth indicated on the Drawings or otherwise required, compressing the backup material 25% to 50% and securing a positive fit.

3.04 Priming

Use only the primer approved by the Owner for the particular installation, applying in strict accordance with the manufacturer's recommendations as approved by the Owner.

3.05 Bond-Breaker Installation

Provide an approved bond-breaker where recommended by the manufacturer of the sealant, and where directed by the Owner, adhering strictly to the manufacturers' installation recommendations.

3.06 Installation of Sealants

- A. Prior to start of installation in each joint, verify the joint type according to details on the Drawings, or as otherwise directed by the Owner, and verify that the required proportion of width of joint to depth of joint has been secured.
- B. Equipment
 - 1. Apply sealant under pressure with power-actuated hand gun or manually-operated hand gun, or by other appropriate means.
 - 2. Use guns with nozzle of proper size, and providing sufficient pressure to completely fill the joints as designed.
- C. Thoroughly and completely mask joints where the appearance of primer or sealant on adjacent surfaces would be objectionable.
- D. Install the sealant in strict accordance with the manufacturer's recommendations, thoroughly filling joints to the recommended depth.
- E. Tool joints to the profile shown on the Drawings, or as otherwise required if such profiles are not shown on the Drawings.
 - 1. Provide uniformly smooth joints with slightly concave surface.
 - 2. Do not use tooling agent unless specifically so recommended in writing by the manufacturer of the sealant.
- F. Cleaning Up
 - 1. Remove masking tape immediately after joints have been tooled.
 - 2. Clean adjacent surfaces free from sealant as the installation progresses, using solvent or cleaning agent recommended by the manufacturer of the sealant used.
 - 3. Upon completion of the work of this Section, promptly remove from the job site all debris, empty containers, and surplus material derived from this portion of the Work.

END OF SECTION

SECTION 09900
BASIC COATING AND PAINTING SPECIFICATION
FOR WATER AND WASTEWATER FACILITIES

PART 1 - GENERAL

1.01 Scope

- A. The work included in this section consists of furnishing all labor, materials, apparatus, scaffolding and all appurtenant work in connection with coating and painting, as indicated on the drawings and as specified herein.
- B. In general, the following surfaces are to be coated or painted:
1. Exposed piping and other metal surfaces, interior and exterior.
 2. All submerged and intermittently submerged metal surfaces, except stainless steel.
 3. All structural and miscellaneous steel, including tanks.
 4. The interior of wet wells, manholes, junction structures, headworks, and similar structures.
 5. All exterior above ground concrete and masonry.
 6. The interior of certain structures as specified in the Painting and/or Coating Schedule.
 7. Equipment furnished with and without factory finish surfaces.
 8. Doors, frames, woodwork and architectural trim work.
- C. The following surfaces shall not be coated or painted unless shown or specified herein, or elsewhere in the Contract Documents.
1. Stainless steel.
 2. Equipment nameplates, machined surfaces and grease fittings.
 3. Non-ferrous and galvanized ferrous metal, including: (a) floor gratings, plates and frames, (b) handrailing, (c) stair treads, stringers and supports, (d) ladders and supports, (e) chain link fencing and appurtenances, (f) conduits.
- D. In no case shall any concrete, wood, metal or any other surface requiring protection be left uncoated or unpainted, even though not specifically defined herein.

1.02 Reference Specifications and Standards

Without limiting the general aspects of other requirements of these specifications, all surface preparation, coating and painting of surfaces shall conform to the applicable requirements of the National Association of Corrosion Engineers (NACE), the Steel Structures Painting Council (SSPC), the American Concrete Institute, the Forest Products Research Society, and the manufacturer's printed recommendations.

In the event of a conflict between codes, reference standards, drawings, and these specifications, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the Owner for clarification and direction prior to ordering or providing any materials or labor.

1.03 Painting Subcontractor

Where protective coatings are to be performed by a subcontractor, said subcontractor must possess a valid state license as required for performance of the painting and coating work called for in this specification and shall have a minimum of five years practical experience and successful history in the application of specified products to surfaces and facilities of water and wastewater treatment facilities. Upon request, he shall substantiate this requirement by furnishing a list of references.

1.04 Shop Drawing Submittals

For each coating system to be used, the Contractor shall submit for Owner's review and approval the following data:

1. Paint manufacturer's data sheet for each product used, including statements on the suitability of the material for the intended use.
2. Paint manufacturer's instructions and recommendations on surface preparation and application.
3. Samples of colors and finishes available for each product. Where custom mixed colors are specified (e.g. to match colors of existing coated surfaces), the submitted color samples shall be made using color formulations prepared to match the color samples furnished or specified by the Owner. The color formula shall be provided with each color sample.
4. Compatibility of shop and field applied coatings (where applicable).
5. Material safety data sheet for each product used.

1.05 Quality Assurance

A. Surface Preparation

Surface preparation will be based upon comparison with "Pictorial Surface Preparation Standards for Painting Steel Surfaces", SSPC-Vis 1 ASTM Designation D220; "Standard Methods of Evaluating Degree of Rusting on Painted Steel Surfaces", SSPC-Vis 2 ASTM Designation D610; Visual Standard for Surfaces of New Steel Airblast Cleaned

with Sand Abrasive", NACE Standard TM-01-70; and as described below. Anchor profile for prepared surfaces shall be measured by use of a non-destructive instrument such as a Keane-Tator Surface Profile Comparator.

To facilitate inspection, the Contractor shall on the first day of sandblasting operations, sandblast metal panels to the standard specified. Plates shall be 1/8" (3.75 mm) plate stock and shall measure a minimum of 8-1/2" x 11" (216 mm x 280 mm). After mutually agreeing a specific panel meets the requirement of the specification, it shall be initialed by the Contractor and Inspector and securely sealed in clear plastic with desiccant to prevent rusting. Panels shall be prepared for each type sandblasting specified and shall be utilized by the Inspector throughout the duration of sandblasting operations.

B. Coating and Painting Application

No coating or paint shall be applied: when the surrounding air temperature or the temperature of the surface to be coated or painted is below 40°F (4.4°C); to wet or damp surfaces or in rain, snow, fog, or mist; when the temperature is less than 5°F (2.8°C) above the dew point; when it is expected the air temperature will drop below 40°F (4.4°C) or less than 5°F (2.8°C) above the dew point within 8 hours after application of coating or paint. Dewpoint shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychrometric Tables.

If above conditions are prevalent, coating or painting shall be delayed or postponed until conditions are favorable. The day's coating or painting shall be completed in time to permit the film sufficient drying time prior to damage by atmospheric conditions.

C. Inspection

Concrete, non-ferrous metal, plastic and wood surfaces shall be visually inspected to insure proper and complete coverage has been attained. A destructive testing instrument, such as a Tooke Gage, shall be used if deemed necessary. Thickness of coatings and paint on ferrous metal surfaces shall be checked with a non-destructive, magnetic type dry film thickness gauge. Coating integrity of Systems A and C surfaces shall be tested with an approved inspection device. Holiday detectors shall not exceed the voltage recommended by the manufacturer of the coating system. For film thicknesses between 10 and 20 mils (0.25 mm and 0.50 mm) a non-sudsing type wetting agent such as Kodak Photo-Flo, shall be added to the water prior to wetting the detector sponge. All pinholes shall be marked, repaired in accordance with the manufacturer's printed recommendations and retested. No pinholes or other irregularities will be permitted in the final coating.

In cases of dispute concerning film thickness or "holidays", the Owner's calibrated instruments and measurements shall predominate. Wide film thickness discrepancies shall be measured and verified with a micrometer or other approved measuring instrument.

Contractor shall give the Owner a minimum of 3 working days advance notice of the start of any field surface preparation work or coating application work, and a minimum

of 7 working days advance notice of the start of any shop surface preparation work or coating application work.

D. Inspection Devices

The Contractor shall furnish, until final acceptance of coating and painting, inspection devices in good working condition for detection of holidays and measurement of dry-film thickness of coating and paint. The Contractor shall also furnish U.S. Department of Commerce, National Bureau of Standards certified thickness calibration plates to test the accuracy of dry-film thickness gauge and certified instrumentation to test the accuracy of holiday detectors.

Dry-film thickness gauges shall be made available for the Owner's use at all times until final acceptance of application. Holiday detection devices shall be operated by the Contractor in the presence of the Owner. Acceptable devices for ferrous metal surfaces include, but are not limited to K-D "Bird-Dog" holiday detector for coatings to 20 mils (0.50 mm) dry film thickness, Tinker-Razor Models AP and AP-W holiday detectors for coatings in excess of 20 mils (0.50 mm) dry-film thickness, and "Owner" units for dry-film thickness gauging. Non-ferrous metal surfaces shall be checked with an instrument such as an Elcometer "Eddy Current" Tester. Inspection devices shall be operated in accordance with the manufacturer's instructions.

E. Warranty Inspection

Warranty inspection shall be conducted during the eleventh month of the Contract warranty period. The Contractor and a representative of the coating material manufacturer shall attend this inspection. All defective work shall be repaired in accordance with this specification and to the satisfaction of the Owner.

1.06 Safety and Health Requirements

A. General

Surface preparation and application of coatings shall be performed by the Contractor in compliance with all applicable federal, state, and local occupational safety, health, and air pollution control regulations. The Contractor shall obtain and comply with all safety precautions recommended by the paint manufacturer in printed instructions or special bulletins. The Contractor shall provide and require use of personnel protective lifesaving equipment for persons working in or about the project site.

B. Head and Face Protection and Respiratory Devices

Equipment shall include protective helmets which shall be worn by all persons while in the vicinity of the work. In addition, workers engaged in or near the work during sandblasting shall wear eye and face protection devices and air-purifying, half-mask or mouthpiece respirator with appropriate filter.

C. Ventilation

Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Ventilation shall reduce the concentration of air contaminant to the degree a hazard does not exist.

D. Sound Levels

Whenever the occupational noise exposure exceeds the maximum allowable sound levels, the Contractor shall provide and require the use of approved ear protective devices.

E. Illumination

Adequate illumination shall be provided while work is in progress, including explosion-proof lights and electrical equipment. Whenever required by the Owner, the Contractor shall provide additional lighting and necessary supports to illuminate all areas to be inspected. The level of illumination for inspection purposes shall be determined by the Owner.

F. Temporary Ladders and Scaffolding

All temporary ladders and scaffolding shall conform to applicable safety requirements. They shall be erected where requested by the Owner to facilitate inspection and be moved by the Contractor to locations requested by the Owner.

1.07 Extra Stock

Upon completion of all coating and painting work, Contractor shall deliver to the Owner a minimum of two 1 gallon cans of each type and color of finish paint and coating used on the project and two 1 gallon cans of each primer. Each container shall be unopened and properly labeled for identification and have a manufacture date within two months of the date of delivery to the Owner.

PART 2 - PRODUCTS

2.01 General

- A. Products specified are those which have been evaluated for the specific service and are listed to establish a standard of quality. Requests for product substitution are subject to the requirements of section "Contractor Submittals Technical Specifications".
- B. All materials shall be brought to job site in original sealed containers. Contractor shall provide coating material name, formula or specification number, batch number, color and date of manufacture to the Owner. Coating materials shall not be used until the Owner has inspected contents and checked information on containers or label. Materials exceeding storage life recommended by the manufacturer shall be rejected.

- C. All coatings and paints shall be stored in enclosed structures to protect them from weather and excessive heat or cold. Flammable coatings or paints must be stored to conform with city, county, state, and federal safety codes for flammable coating or paint materials. Water based coatings or paints shall be protected from freezing.
- D. Contractor shall use products of same manufacturer for all coating systems unless approved in writing by the Owner.
- E. It is the intent of this specification that all coatings used meet local, state, and federal air pollution control regulations. These regulations change frequently. If a listed coating does not meet local, state, and federal air pollution control regulations at the time the work is actually performed, the Contractor shall provide the manufacturer's compliant, recommended substitute coating at no additional cost to the Owner.

2.02 Service Condition A

Ferrous metals subject to corrosive moisture or atmosphere and condensation such as outside of tanks, out-of-doors piping, valves, and equipment, bridges over process units, etc. shall receive the following surface preparation and coating:

A. Surface Preparation

All surfaces shall be field sandblasted in conformance with Steel Structures Painting Council Specifications SSPC-SP10 and National Association of Corrosion Engineers Surface Finish NACE No. 2 (Near-White Blast Cleaning) to achieve a 1.5-2.5 mil (40-60 micron) blast profile.

B. Application

Application shall be in strict accordance with manufacturer's recommendations. The minimum and maximum required times between coats shall be per the manufacturer's product data sheet. Written requests for shop surface preparation and application of the prime coat shall be reviewed and approved by Owner on a case-by-case basis. If approved by Owner, shop applied prime coat surface shall be field scarified by brush-blasting prior to application of intermediate coat.

C. Coating System

Except as otherwise noted, the prime coat shall have a minimum dry film thickness (MDFT) of 4.0 mils. The intermediate coat shall have a MDFT of 4.0 mils and the finish coat shall have a MDFT of 2.0 mils. The total dry film thickness of the complete system shall be 10.0 mils, minimum.

Carboline System	Primer - Carboline 893 Intermediate - Carboline 890 Finish - Carbothane 134HG
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Ameron System	Primer - Amercoat 385 Intermediate - Amercoat 385 Finish - Amercoat 450 HS
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Tnemec System

Primer - Series 69 Hi-Build Epoxoline II
Intermediate - Series 69 Hi-Build Epoxoline II
Finish - Series 74 Endurashield

2.03 Service Condition B

Ferrous metals not subject to corrosive moisture or atmosphere and condensation; normal indoor or outdoor exposure such as metal doors, other architectural items; piping, valves, and pumps indoors, etc. shall receive the following surface preparation and coating:

A. Surface Preparation

All surfaces shall be field sandblasted in conformance with SSPC-SP6 and NACE No. 3 (Commercial Blast Cleaning).

B. Application

Application shall be in strict accordance with manufacturer's recommendations. The minimum and maximum times required between coats shall be per the manufacturer's product data sheet. Written requests for shop surface preparation and application of the prime coat shall be reviewed and approved by Owner on a case-by-case basis. If approved by Owner, shop applied prime coat surface shall be scarified by brush-blasting prior to application of finish coat.

C. Coating System

Except as otherwise noted, the prime coat shall have a MDFT of 4.0 mils. The finish coat (one or more) shall have a MDFT of 3.0 mils. The total dry film thickness of the complete system shall be 7.0 mils, minimum.

Carboline System

Primer - Carboline 893
Finish - Carbothane 134 HG

Ameron System

Primer - Amercoat 385
Finish - Amercoat 450 HS

Tnemec System

Primer - Series 69 Hi-Build Epoxoline II
Finish - Series 74 Endurashield

2.04 Service Condition C

Ferrous metals submerged or intermittently submerged in sewage or similar corrosive liquid, shall receive the following surface preparation and coating:

A. Surface Preparation

All surfaces shall be field sandblasted in conformance with SSPC-SP10 and NACE No. 2 (Near-White Blast Cleaning) to achieve a 2-4 mil (50-100 micron) blast profile.

B. Application

Application shall be in strict accordance with manufacturer's recommendations. If recoating is required to correct pinholes, holidays or insufficient coating thickness; surfaces shall be scarified by brush-blasting prior to recoat.

C. Coating System

Except as otherwise noted, one coat shall be applied at a MDFT of 16.0 mils.

Carboline System	Bitumastic 300M (coal tar epoxy)
Ameron System	Amercoat 78HB (coal tar epoxy)
Tnemec System	Series 46H-413 Hi-Build Tneme-Tar (coal tar epoxy)

2.05 Service Condition D

Buried metal surfaces shall receive the following surface preparation and coating:

A. Surface Preparation

All surfaces shall be cleaned in conformance with SSPC-SP3 (Power Tool Cleaning) or SSPC-SP6 and NACE No. 3 (Commercial Blast Cleaning).

B. Application

Application shall be in strict accordance with manufacturer's recommendations. The minimum time required between coats and prior to backfilling shall be per the manufacturer's product data sheet.

C. Coating System

Except as otherwise noted, two or more coats shall be applied to a minimum total dry film thickness of 30 mils.

Carboline System	Bitumastic
Ameron System	Base Coat - Amerlastic 281 (15 mils MDFT) Top Coat - Amerlastic 282 (15 mils MDFT)
Tnemec System	Series 46-465HB Tnemecol (coal tar)

2.06 Service Condition E

Ferrous metals subject to high temperature exposure (resistant to 1000°F, continuous) shall receive the following surface preparation and coating:

A. Surface Preparation

All surfaces shall be field sandblasted in conformance with SSPC-SP10 and NACE No. 2 (Near-White Blast Cleaning) to achieve a 1.0 mil (25 micron) blast profile.

B. Application

Application shall be in strict accordance with manufacturer's recommendations. The maximum dry film thickness of this system shall not exceed the limits established by the manufacturer.

C. Coating System

Except as otherwise noted, two coats shall be applied at 1.0 mil per coat to a total 2.0 mil dry film thickness for the system.

Carboline System	Primer - Carboline 4631 Finish - Carboline 4631
Ameron System	Primer - Amercoat 892HS Finish - Amercoat 892HS
Tnemec System	Primer - Series 39 Silicone Aluminum Finish - Series 39 Silicone Aluminum

2.07 Service Condition F

Non-ferrous or galvanized ferrous metals, specifically identified in the Contract Documents as requiring coating, shall receive the following surface preparation and coating:

A. Surface Preparation

All surfaces shall be cleaned in conformance with Steel Structures Painting Council Specifications SSPC-SP1 (solvent cleaning).

B. Application

Application shall be in strict accordance with manufacturer's recommendations.

C. Coating System

Except as otherwise noted, one pre-treatment coat shall be applied to a minimum dry film thickness of 0.5 mils and shall be self priming on non-ferrous metals and galvanized surfaces. The primer and finish coats shall be the system recommended for the specific Service Condition.

Carboline System	Pre-Treatment Coat – Rustbond LT or Rustbond Penetrating Sealer SG
Ameron System	Pre-Treatment Coat - Galvaprep (Parker Amchem)

2.08 Service Condition G

Metals finished with asphalt, coal tar, or other bleeding type finish, specifically identified in the Contract Documents as not requiring removal prior to field coating, shall receive the following surface preparation and coating:

A. Surface Preparation

All surfaces shall be cleaned in conformance with Steel Structures Painting Council Specification SSPC-SP1 (Solvent Cleaning).

B. Application

Application shall be in strict accordance with manufacturer's recommendations.

C. Coating System

Except as otherwise noted, one barrier coat shall be applied to a MDFT of 3.0 mils. Finish coats shall be the system recommended for the specific Service Condition.

Carboline System	Barrier Coat - Carboline 890
Ameron System	Barrier Coat - Amerlock 400
Tnemec System	Barrier Coat - Series 69 Hi-Build Epoxoline II

2.09 Service Condition H

Submerged moving parts where resistance to sewage or chemicals is required and drying coatings cannot obtain proper bond or effective film thickness (includes cables, chains, gears, pulleys, etc.), shall receive the following surface preparation and coating:

A. Surface Preparation

All surfaces shall be cleaned in conformance with Steel Structures Painting Council Specification SSPC-SP2 (Hand Tool Cleaning).

B. Application

Application shall be in strict accordance with manufacturer's recommendation.

C. Coating System

One coat of grease coating applied at the rate of coverage of 40 square feet per gallon.

Carboline/
Kop-Coat System

Kop-Coat Intertol Grease Coating

2.10 Service Condition I

Concrete subject to continuous or intermittent submergence in sewage, scum, sludge or other corrosive liquid where specified shall receive the following surface preparation and coating:

A. Surface Preparation

All surfaces shall be thoroughly cleaned by sandblasting or other approved methods, removing all traces of previous materials. Remove all loose concrete by chipping, etc. to leave only sound firmly bonded concrete. All cracks and voids shall be filled with the specified epoxy filler and surfacer. Final surface shall be smooth and free of voids, cavities, dirt, dust, oils, grease, laitance or other contaminants.

B. Application

Application shall be in strict accordance with manufacturer's recommendations. The minimum and maximum required times between coats shall be per the manufacturer's product data sheet. If recoating is required to correct pinholes or insufficient system coating thickness, surfaces shall be brush-blasted prior to recoat.

C. Coating System

The prime coat shall be applied at a coverage rate not to exceed 200 S.F. per gallon. Finish coats shall be two or more coats to a total dry film thickness of 16.0 mils (minimum) for the system.

Carboline System

Filler – Sentry 610
Primer - Bitumastic 300M
Finish - Bitumastic 300M

Ameron System

Filler - NU-KLAD 114A
Primer - Amercoat 385
Finish - Amercoat 351

Tnemec System

Filler - Series 63-1500 Epoxy Filler and Surfacers
Primer - Series 46H-413HB Tnemec-Tar Thinned
30% with Tnemec #2 Thinner
Finish - Series 46H-413HB (undiluted)

2.11 Service Condition J

Concrete surfaces subject to corrosive spillage and mechanical wear shall receive the following surface preparation and coating:

A. Surface Preparation

All surfaces shall be thoroughly cleaned by sandblasting or other approved methods, removing all traces of previous materials. Remove all loose concrete by chipping, etc. to leave only sound firmly bonded concrete. All cracks and voids shall be filled with the specified filler and surfacer. Final surface shall be smooth and free of voids, cavities, dirt, dust, oils, grease, laitance or other contaminants.

B. Application

Application shall be in strict accordance with manufacturer's recommendations. The minimum and maximum required times between coats shall be per the manufacturer's product data sheet. If recoating is required to correct pinholes of insufficient system coating thickness, surfaces shall be brush-blasted prior to recoat.

C. Coating System

Total dry film thickness of the complete system shall be 24.0 mils, minimum.

Ameron System	Filler - NU-KLAD 114A Primer - Amercoat 385 (6 mils MDFT) Finish - Amercoat 351 (9 mils MDFT, each coat)
Tnemec System	Filler - Series 120-5003 Vinester F&S Primer - Series 120-5002 Beige Vinester (12 mils MDFT) Finish - Series 120-5001 Gray Vinester (12 mils MDFT)
Carboline	Filler - Sentry 610 Primer - Sentry 140 (15 mils MDFT) Finish - Sentry 140 (15 mils MDFT)

2.12 Service Condition K

Interior and exterior concrete surfaces exposed to view, not subject to immersion and not subject to pedestrian traffic, and concrete block and masonry without integral color or architectural treatment, shall receive the following surface preparation and coating:

A. Surface Preparation

All surfaces shall be thoroughly cleaned by sandblasting or other approved methods, removing all traces of previous materials. Remove all loose concrete, mortar splatter and protrusions by chipping, etc. to leave only sound firmly bonded concrete, concrete block, or masonry. All cracks and voids shall be filled with an approved concrete and masonry patching compound. Final surface shall be smooth and free of voids, cavities, dirt, dust, oils, grease, laitance or other contaminants.

B. Application

Application shall be in strict accordance with manufacturer's recommendations. A minimum of 12 hours is required before additional coats may be applied to the prime coat and two hours for the finish coats.

C. Coating System

Prime coat shall be applied at a rate of 75-100 square feet per gallon. A minimum of two finish coats shall be applied at a coverage rate not to exceed 150 square feet per gallon per coat.

Carboline System

Primer - Flexxide Block Filler
Finish - Flexxide HB (Smooth)

Ameron System

Primer - Amerlastic 172
Finish - Amerlastic 290 LT (Smooth) or Amerlastic 290 TC (Textured)

Tnemec System

Primer - Series 130 Envirofill
Finish - Series 180 (Smooth) or 181 (Textured)

2.13 Service Condition L

Concrete floors subject to corrosive moisture and pedestrian traffic where specified shall receive the following surface preparation and coating:

A. Surface Preparation

All surfaces shall be thoroughly cleaned by sandblasting or other approved methods; removing all traces of previous materials. Remove all loose concrete by chipping, etc. to leave only sound firmly bonded concrete. Cracks and voids shall be repaired or filled with the specified filler and surfacer. Final surfaces shall be smooth and free of voids, cavities, dirt, dust, oils, grease laitance or other contaminants.

B. Application

Application shall be in strict accordance with manufacturer's recommendation. Where a non-skid finish is specified broadcast #50 dry washed silica sand onto primer coat while still wet and follow with finish coat after required drying time.

C. Coating System

Prime coat shall be thinned 15-20% with manufacturer recommended thinner and applied at a coverage rate not to exceed 250 square feet per gallon. Finish coat shall be applied at a coverage rate not to exceed 200 square feet per gallon. Total dry film thickness of the complete system shall be a minimum of 10 mils.

Carboline System	Filler – Sentry 610 Primer - Carboline 890 Finish - Carboline 890
Ameron System	Filler - NU-KLAD 114A Primer - Amerlock 400 Finish - Amerlock 400
Tnemec System	Filler - Series 63-1500 Filler and Surfacer Primer - Series 104 H.S. Epoxy Finish - Series 104 H.S. Epoxy

2.14 Service Condition M

Concrete and concrete block masonry furnished with an approved architectural finish (e.g. integral color or architectural treatment) shall receive the following surface preparation and clear sealing system:

A. Surface Preparation

All surfaces shall be cleaned of all dirt, dust, grease, and other foreign matter before sealing.

B. Application

Application shall be in strict accordance with manufacturer's recommendations.

C. Coating System

Apply one coat at a coverage rate not to exceed 100 square feet per gallon.

Carboline System	Floorshield 2000
Monopole System	Monochem Aquaseal

2.15 Service Condition N

Interior and exterior architectural woodwork and interior gypsum board shall receive the following surface preparation and coating:

A. Surface Preparation

1. Interior and Exterior Woodwork

Sand new and bare wood to remove any surface contamination and surface cells. For previously coated surfaces sand loose paint to a tight, adherent surface. Cracks, nail holes, and other defects shall be filled with putty or plastic wood after priming. All knots shall be sealed with an approved knot sealer. Prior to coating, all surfaces shall have a moisture content below level recommended by coating manufacturer and be thoroughly cleaned and free of all foreign matter.

2. Interior Gypsum Board

Tape new gypsum board joints and top with a total of three applications of joint compound. Sand joints after each coat. Spray gypsum board with a light texture coat. Owner shall approve a test section prior to texture coating.

B. Application

Application shall be in strict accordance with manufacturer's recommendations.

C. Coating System

Prime coat shall be applied at a coverage rate not to exceed 280 square feet per gallon. The finish coat shall be applied at a coverage rate not to exceed 280 square feet per gallon.

Carboline System	Primer - Carboline 3359 (semi-gloss) Finish - Carboline 3359 (semi-gloss)
Ameron System	Primer - Amercoat 220 (satin or gloss) Finish - Amercoat 220 (satin or gloss)
Tnemec System	Primer - Series 6 (flat) or 7 (semi-gloss) Finish - Series 6 (flat) or 7 (semi-gloss)

Prior to application of coating system, new gypsum board shall be coated with a sealer recommended by the coating manufacturer and approved by the Owner, or an additional prime coat of the specified system shall be applied.

2.16 Service Condition O

Exposed plastic and fiberglass surfaces, specifically identified in the Contract Documents as requiring coating, shall receive the following surface preparation and coating (coating to be used

for this category shall be certified by the plastic and fiberglass manufacturer to be completely acceptable and non-injurious to the material):

A. Surface Preparation

Surface preparation shall consist of hand sanding to remove gloss. All remaining dust shall be removed with vacuum brushing or tack rag. Sanded surfaces shall not be washed with either solvent or water.

B. Application

Application shall be in strict accordance with manufacturer's recommendations.

C. Coating System

Except as otherwise noted, two coats shall be applied at 2.0 mils per coat to a total 4.0 mil MDFT for the system.

Carboline System	Carbothane 134 HG
Ameron System	Amercoat 450 HS
Tnemec System	Series 74 Endurashield

2.17 Service Condition P

Manufactured items furnished with shop-applied coat of primer requiring field touch-up or with a shop applied primer which is not compatible with the required coating system shall receive the following surface preparation and coating system:

A. Surface Preparation

All surfaces shall be cleaned in conformance with Steel Structures Painting Council Specification SSPC-SP2 (Hand Tool Cleaning), including hand sanding and feathering of damaged areas. If determined by the Owner that damage is too extensive for touch-up, item shall be re-cleaned and coated or painted as directed by Owner.

B. Coating System

Prime and finish coats shall be the system recommended for the specific Service Condition. Prime coat shall be compatible with the required system. If not (as determined by the Owner) the prime coat shall either be removed by sandblasting or coated with a suitable primer which is compatible with the shop primer utilized and the coating system required. Costs incurred for repair or replacement of shop-applied primers shall be the sole responsibility of the Contractor.

2.18 Service Condition Q

Manufactured items furnished with shop-applied primer and finish coats requiring field touch-up shall receive the following surface preparation and coating system:

A. Surface Preparation

All surfaces shall be cleaned in conformance with Steel Structures Painting Council Specification SSPC-SP2 (Hand Tool Cleaning), including hand sanding and feathering of damaged areas. If determined by the Owner that damage is too extensive for touch-up, item shall be recleaned and coated or painted as directed by Owner.

B. Coating System

Prime and finish coats shall be the system recommended for the specific Service Condition. Costs incurred for repair or replacement of shop-applied coatings or finishes shall be the sole responsibility of the Contractor.

2.19 Service Condition R

Ferrous metal tanks, vessels, or equipment containing raw water or potable water shall receive the following surface preparation and coating:

A. Surface Preparation

All interior surfaces, including miscellaneous accessories and components, submerged or unsubmerged, shall be field sandblasted in conformance with SSPC-SP10 and NACE No. 2 (Near-White Blast Cleaning) to achieve a 2-4 mil (50-100 micron) blast profile.

All exterior surfaces, including miscellaneous accessories and components, shall be field sandblasted in conformance with SSPC-SP6 and NACE No. 3 (Commercial Blast Cleaning).

B. Application

Application shall be in strict accordance with manufacturer's recommendations. The minimum and maximum required times between coats shall be per the manufacturer's product data sheet. Written requests for shop surface preparation and application of the prime coat shall be reviewed and approved by Engineer on a case-by-case basis. If approved by Engineer, shop applied prime coat surface shall be field scarified by brush-blasting prior to application of finish coat.

C. Coating System

Interior Surfaces:

Interior coating system shall be certified by the National Sanitation Foundation to be in accordance with ANSI/NSF Standard 61 for potable water contact.

Except as otherwise noted, the prime coat shall have a MDFT of 6.0 mils. The finish coat shall have a MDFT of 6.0 mils. The total dry film thickness of the complete system shall be 12.0 mils, minimum.

Carboline System	Primer - Super Hi-Gard 891 Finish - Super Hi-Gard 891
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Tnemec System	Primer - Series 139 Pota-Pox II Finish - Series 139 Pota-Pox II
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Exterior Surfaces:

Except as otherwise noted, the prime coat shall have a MDFT of 6.0 mils. The finish coat (one or more) shall have a MDFT of 3.0 mils. The total dry film thickness of the complete system shall be 9.0 mils, minimum.

Carboline System	Primer - Super Hi-Gard 891 Finish - Carbothane 134 HG
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Tnemec System	Primer - Series 139 Pota-Pox II Finish - Series 74 Endurashield
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2.20 Service Condition S

Concrete seal/waterproofing shall be Vandex Super or Xypex.

2.21 Miscellaneous Coatings

A. Aluminum Metal Isolation

All aluminum bearing on, or embedded in, concrete shall be coated with a wash primer (0.5 mils) followed by one coat (8 mils) of heavy bodied bituminous paint, Carboline Bitumastic Super Service Black or Tnemec 46-465.

PART 3 - EXECUTION

3.01 General

A. All surface preparation, coating and painting shall conform to applicable standards of the National Association of Corrosion Engineers, the Steel Structures Painting Council, the American Concrete Institute, the Forest Products Research Society, and the Manufacturer's printed instructions. Material applied prior to approval of surface

preparation by the Owner shall be removed and reapplied to the satisfaction of the Owner at the expense of the Contractor.

- B. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice. Continuity of personnel shall be maintained and transfers of key personnel shall be coordinated with the Owner.
- C. Unless otherwise specified, dust, dirt, oil, grease or any foreign matter that will affect the adhesion or durability of the finish must be removed by washing with clean rags dipped in an approved cleaning solvent and wiped dry with clean rags.
- D. Coating and painting systems include surface preparations, prime coatings and finish coatings. Surface preparation for a specific Service Condition shall be as specified for that coating or painting system. Unless otherwise specified, prime coatings shall be field applied. Where prime coatings are shop applied, they shall be thoroughly cleaned and touched up in the field as specified. If shop coatings are deficient or damaged too extensively for adequate repair, they shall be removed and coated and painted as directed by the Owner. Contractor shall instruct suppliers to provide prime coats compatible with the finish coats specified. Any off site work which does not conform to this specification is subject to rejection by the Owner.
- E. The Contractor's coating and painting equipment shall be designed for application of materials specified and shall be maintained in first class working condition. Compressors shall have suitable traps and filters to remove water and oils from the air. Contractor's equipment shall be subject to approval by the Owner.

3.02 Surface Preparation, Ferrous Metal

A. General

The latest revision of the following surface preparation specifications of the Steel Structures Painting Council and the National Association of Corrosion Engineers shall form a part of this specification:

1. Solvent Cleaning (SSPC-SP1). Removal of oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning or similar materials and methods which involve a solvent or cleaning action.
2. Hand Tool Cleaning (SSPC-SP2). Removal of loose rust, loose mill scale and other detrimental foreign matter to degree specified by hand chipping, scraping, sanding and wire brushing.
3. Power Tool Cleaning (SSPC-SP3). Removal of loose rust, loose mill scale and other detrimental foreign matter to degree specified by power wire brushing, power impact tools or power sanders.
4. White Metal Blast Cleaning (SSPC-SP5). Blast cleaning to a gray-white uniform metallic color until each element of surface area is free of all visible residues.

5. Commercial Blast Cleaning (SSPC-SP6 and NACE No. 3). Blast cleaning until at least two-thirds of each element of surface area is free of all visible residues.
 6. Brush-Off Blast Cleaning (SSPC-SP7 and NACE No. 4). Blast cleaning to remove loose rust, loose mill scale and other detrimental foreign matter to degree specified.
 7. Near White Blast Cleaning (SSPC-SP10 and NACE No. 2). Blast cleaning to nearly white metal cleanliness, until at least 95% of each element of surface area is free of all visible residues.
- B. Slag and weld metal accumulation and spatters not removed by the fabricator, erector, or installer shall be removed by chipping and grinding. All rough welds shall be ground smooth and sharp edges shall be ground to approximately 1/8" radius.
 - C. Field blast cleaning for all surfaces shall be dry sandblasting unless otherwise directed.
 - D. The Contractor shall comply with all applicable local, state, and federal, air pollution control regulations for blast cleaning.
 - E. All oil, grease, welding fluxes and other surface contaminants shall be removed by solvent cleaning per SSPC-SP1 prior to blast cleaning.
 - F. Maximum particle size of abrasives used in blast cleaning shall be that which will produce a surface profile in accordance with these specifications and the recommendations of the manufacturer of the specified coating system to be applied.
 - G. Sand used in blast cleaning operations shall be washed, graded and free of contaminants that would interfere with adhesion of coating or paint and shall not be reused.
 - H. Shop applied temporary coatings or shop applied coatings of unknown composition shall be completely removed before the specified coatings are applied.
 - I. During blast cleaning operations, caution shall be exercised to insure that existing coatings or paint are not exposed to abrasion from blast-cleaning.
 - J. The Contractor shall keep the area of his work in a clean condition and shall not permit blasting materials to accumulate as to constitute a nuisance or hazard to the prosecution of the work or the operation of the existing facilities.
 - K. Surfaces shall be cleaned of all dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming or another approved method prior to application of specified coatings or paint. No coatings or paint shall be applied over damp or moist surfaces.
 - L. All welds shall be neutralized with a suitable chemical compatible with the specified coating materials.

3.03 Surface Preparation, Galvanized Ferrous Metal

Prior to application of specified pretreatment coating, galvanized ferrous metal shall be alkaline cleaned per SSPC-SP1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system to be used.

3.04 Surface Preparation, Ferrous Metal with Existing Coatings

- A. All grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined by laboratory testing.
- B. The Contractor shall provide the degree of cleaning specified in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not specified in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC-SP6, Commercial Blast Cleaning. Areas of tightly adhering coatings shall be cleaned to SSPC-SP7, Brush-off Blast Cleaning, with the remaining thickness of existing coating not to exceed 3 mils.
- C. If coatings to be applied are not compatible with existing coatings the Contractor shall apply intermediate coatings per the paint manufacturer's recommendation for the specified coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.
- D. Coatings of unknown composition shall be completely removed prior to application of new coatings.

3.05 Surface Preparation, Concrete and Masonry

- A. Surface preparation shall not begin until at least 30 days after the concrete or masonry has been placed.
- B. All oil, grease, and form release and curing compounds shall be removed by detergent cleaning per SSPC-SP1 before abrasive blast cleaning.
- C. Concrete and masonry surfaces and deteriorated concrete surfaces to be coated shall be abrasive blast cleaned to remove existing coatings, laitance, deteriorated concrete, and to roughen the surface. The abrasive used should be dry and clean with the maximum particle size that will pass through a 16 mesh screen. Cracks and voids shall be repaired or filled with the specified filler and surfacer. Final surface shall be sound, firmly bonded, smooth and free of voids, cavities, dirt, dust, oils, grease, laitance, or other contaminants.
- D. Residual abrasive, dust and loose particles shall be removed from the surface by vacuuming or blowing off with dry high pressure air.
- E. Unless required for proper adhesion, surfaces shall be dry prior to coating. The presence of moisture shall be determined with an approved moisture detection device.

3.06 Surface Preparation, Wood and Composition Materials

All surfaces shall be cleaned of dirt, oil, or other foreign substances with mineral spirits, scrapers, sandpaper, or wire brushes. Finished surfaces exposed to view shall, if necessary, be made smooth by planing or sandpapering. Small, dry, seasoned knots shall be surface scraped, sandpapered, and thoroughly cleaned, and shall be given a thin coat of WP-578 Western Pine Association knot sealer before application of the priming coat. Large, open unseasoned knots, and all beads or streaks of pitch shall be scraped off, or if the pitch is still soft, it shall be removed with mineral spirits or turpentine and the resinous area shall be thinly coated with knot sealer. After priming, all holes and imperfections shall be filled with putty or plastic wood (colored to match the finish coat), allowed to dry, and sandpapered smooth. Existing surfaces shall be cleaned of all loose or flaking paint and sandpapered to a tight, adherent surface.

3.07 Coating and Painting Application, General

- A. Coating and painting application shall conform to the requirements of the Steel Structures Painting Council Paint Application Specifications SSPC-PA1, latest revision, for "Shop, Field and Maintenance Painting", and recommended practices of the National Association of Corrosion Engineers, the American Concrete Institute, the Forest Products Research Society and the Manufacturer of the coating and paint materials.
- B. Application of the first coat shall follow immediately after surface preparation and cleaning and within an eight hour working day. Any cleaned areas not receiving first coat within an eight hour period shall be recleaned prior to application of first coat. Cleaned surfaces and all coats of the specified system shall be inspected prior to application of each succeeding coat. Contractor shall schedule such inspection with Owner in advance.
- C. Prior to assembly, all surfaces made inaccessible after assembly, shall be prepared as specified herein and shall receive the coating or painting system specified.
- D. Thinning shall be permitted only as recommended by the Manufacturer and approved by the Owner.
- E. Coating materials shall be protected from exposure to cold weather, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application.
- F. Each application of coating or paint shall be applied evenly, free of brush marks, sags, runs, and variations in color, texture and finish, with no evidence of poor workmanship. Care shall be exercised to avoid lapping on glass or hardware. Coatings and paints shall be sharply cut to lines. Finished surfaces shall be free from defects or blemishes.
- G. Protective coverings or drop cloths shall be used to protect floors, fixtures and equipment. The working parts of all mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials. Care shall be exercised to prevent coatings or paints from being spattered onto surfaces which are not to be coated or painted. Spray painting shall be conducted under carefully controlled conditions. The Contractor shall be fully responsible for and shall promptly repair any

and all damage to adjacent facilities or adjoining property occurring from blast cleaning or coating operations.

- H. When two or more coats of coating or paint are specified, each coat shall be of a slightly different shade to facilitate inspection of surface coverage of each coat.
- I. Specified film thicknesses per coat for the Service Conditions are minimum required. Contractor shall apply additional coats as necessary to achieve the specified thickness.
- J. All material shall be applied as specified.
- K. All welds and irregular surfaces shall receive a brush coat of the specified product prior to application of the first complete coat.
- L. Cleaning and coating shall be coordinated so that dust and other contaminants from the cleaning process will not fall on wet, newly-coated surfaces.
- M. Drying time between coats and surface curing shall be as recommended by the coating manufacturer depending upon field conditions of temperature and humidity. Times shall be submitted with the shop drawings based on 70°F and relative humidity of 50%.
- N. In the case of enclosed areas, the forced air ventilation system shall operate continuously to provide air circulation and exhausting of solvent vapors.

3.08 Shop Coating

- A. All items of equipment, or parts of equipment which are not submerged in service, shall be shop primed and then finish coated in the field, after installation, with the specified or approved color. The methods, materials, application equipment and all other details of shop painting shall comply with these specifications. If the shop primer requires topcoating within a specified period of time, the equipment shall be finish coated in the shop and then touch-up painted after installation.
- B. All items of equipment, or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have all surface preparation and coating work performed in the field.
- C. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the specified quality in the field. Such equipment shall be shop primed and finish coated and touched up in the field with the identical material after installation. The Contractor shall require the manufacturer of each such piece of equipment to certify as part of its shop drawings that the surface preparation is in accordance with these specifications. Copies of applicable coating manufacturer's material data sheets shall be submitted with equipment shop drawings.
- D. For certain small pieces of equipment the manufacturer may have a standard coating system which is suitable for the intended service conditions. In such cases, the final

determination of suitability will be made during review of the shop drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.

- E. Shop painted surfaces shall be protected during shipment and handling. Primed surfaces shall not be exposed to the weather for more than 6 months before topcoated, or less time if recommended by the coating manufacturer.
- F. Damage to shop-applied coatings shall be repaired in accordance with these specifications and the coating manufacturer's printed instructions.
- G. The Contractor shall make certain that the shop primers and field topcoats are compatible and meet the requirements of these specifications.

3.09 Protective Coating and Painting Schedule

The protective coating and painting schedule provided herein or on the drawings shall indicate the coating system to be used. The schedule shall not be construed as a complete list of all surfaces to be coated but rather as a guide as to the application of the various coating systems. All surfaces shall be coated and painted except those specifically excluded herein or on the drawings.

3.10 Color Scheme

All colors and shades of colors of all coats of paint and protective coating material shall be as selected by the Owner, except as noted below under "Pipe Color Coating". The Contractor shall submit a current chart of the manufacturer's available colors to the Owner at least forty-five days prior to the start of coating and painting operations.

3.11 Pipe Color Coding and Labeling

All exposed piping shall be color coded and labeled to conform to all OSHA requirements and "Scheme for the Identification of Piping Systems" (ANSI A13.1). "State (10) Standards" color scheme shall be used to further identify specific commodity. As a guideline the following color coding schedule is provided. Color codes shall be confirmed with Owner prior to commencing work.

A. Color Code Schedule

<u>Item</u>	<u>Color Code</u>
Aeration Air	Safety Green
Aftercooler Return	Safety Red
Aftercooler Supply	Safety Red
Air Scour	Safety Green
Alum	Safety Yellow/Red Bands
AWT Bypass	Safety Red
Belt Press Return Water	Gray

A. Color Code Schedule

<u>Item</u>	<u>Color Code</u>
Caustic Soda	Safety Orange
Chemical Drain	Safety Orange
Chlorine Gas	Safety Orange
Chlorine Liquid	Safety Orange
Chlorine Solution	Safety Orange
Chlorine Vacuum	Safety Orange
Cold Sludge	Brown
Digested Sludge	Brown
Digested Sludge Exchange	Brown
Drain	Gray
Engine Cooling Water	Safety Red
Engine Exhaust	Safety Red
Filter Backwash	Safety Red
Filter Backwash Return	Safety Red
Filter Effluent	Safety Red
Filter Influent	Safety Red
Fire Water	Safety Red
Flotation Thickener Overflow	Brown
Flotation Thickener Return	Gray
Foul Air	White
Froth Spray	Safety Red
Fuel Oil	Black
Fuel Oil Return	Black
Fuel Oil Supply	Black
Gravity Thickener Overflow	Brown
Ground Water Drainage	Gray
Grit	Brown
Grit Chamber Influent	Brown
Grit Washer Overflow	Gray
Heat Recovery Return	Safety Blue/Orange Bands
Heat Recovery Supply	Safety Blue/Orange Bands
Heated Sludge	Brown/Yellow Bands
Holding Tank Overflow	Brown
High Pressure Digester Gas	Light Yellow
High Temperature Wash Water	Safety Blue/Orange Bands
Hydrogen Peroxide	Safety Orange
Industrial Water	Safety Red
Influent Force Main	Brown

A. Color Code Schedule

<u>Item</u>	<u>Color Code</u>
Jacket Water Return	Safety Red
Jacket Water Supply	Safety Red
Liquid Propane Gas	Light Yellow
Low Pressure Digester Gas	Light Yellow
Lube Oil Return	Black
Lube Oil Supply	Black
Lube Oil Waste	Black
Methanol	Safety Yellow/Red Bands
Natural Gas	Light Yellow
Plant Air	Safety Green/Yellow Band
Plant Effluent	Safety Red
Polymer	Safety Yellow/Blue Bands
Potable Water	Safety Blue
Primary Influent	Brown
Primary Skimmings	Brown
Primary Sludge	Brown
Pumped Drainage Water	Gray
Raw Influent	Brown
Return Activated Sludge	Brown
Return Water	Safety Red
Sample	Safety Red
Sanitary Drain	Gray
Seal Water	Safety Red
Secondary Effluent	Safety Red
Secondary Skimmings	Brown
Secondary Sludge	Brown
Skimmings	Brown
Sludge Heater Bypass	Brown
Sludge Return	Brown
Sludge Transfer	Brown
Spray Wash	Safety Red
Storm Drain	Gray
Sulfer Dioxide Gas	Safety Orange
Sulfer Dioxide Liquid	Safety Orange
Sulfer Dioxide Solution	Safety Orange
Sulfer Dioxide Vacuum	Safety Orange
Tank Drain	Brown
Tertiary Effluent	Safety Red
Thickened Digested Sludge	Brown

A. Color Code Schedule

<u>Item</u>	<u>Color Code</u>
Thickened Sludge	Brown
Thickened Waste Activated Sludge	Brown
Thickener Dilution Water	Safety Red
Vent	White
Ventilation Air	White
Wash Water	Safety Red
Waste Activated Sludge	Brown
Waste Sludge	Brown

B. Label Coding

Pipe labels (or markers) shall be pressure-sensitive, self-adhesive, vinyl film pipe markers as manufactured by Seton Name Plate Corporation, or equal. Background colors, letter colors, letter heights and spacing shall conform with ANSI A13.1. Pipe designation labels and direction-of-flow arrows shall be placed at 10 foot intervals (maximum) and at every change in direction. Pipe designation wordings shall be selected by the Owner and may not correspond to standard wordings available from the manufacturer.

3.12 Cleanup

Upon completion of the work, all staging, scaffolding, and containers shall be removed from the site or destroyed in a manner approved the Owner. Coating or paint spots and oil or stains upon adjacent surfaces shall be removed and the job site cleaned. All damage to surfaces resulting from the work of these specifications shall be cleaned, repaired or refinished to the satisfaction of the Owner and at no additional cost to the Owner.

END OF SECTION

SECTION 09915
FUSION BONDED EPOXY LININGS AND COATINGS
TECHNICAL SPECIFICATIONS

PART 1 - GENERAL

1.01 Description

Where specified on the Drawings or in other Sections of these Specifications, Contractor shall provide piping, fittings, valves, couplings, and appurtenances with fusion bonded epoxy linings and/or coatings. This Section specifies materials, application and testing of one part, fusion bonded, heat cured, thermosetting, 100% solid epoxy linings and coatings on carbon steel, cast iron and ductile iron piping, fittings, valves, clamp-type couplings, transition couplings, and appurtenances.

Fusion bonded epoxy shall not be applied to aluminum, brass, bronze, copper, plastic, rubber, or stainless steel surfaces.

1.02 Submittals

Contractor shall submit shop drawings in accordance with Specification Section 01300, Contractor Submittals Technical Specifications. Contractor shall submit complete information and technical data for all material and components, including, but not limited to, the following:

- A. List of all project materials to receive fusion bonded epoxy linings and coatings.
- B. Manufacturer's descriptive data, technical literature, and material safety data sheets for all products to be applied. As a minimum, data sheets shall contain the following information:
 - 1. Description of the physical and chemical properties of the epoxy demonstrating compliance with the requirements herein.
 - 2. Description of the application and curing procedure.
 - 3. Description of the shop repair procedures to be used.
- C. Coating application test records for measuring coating thickness and holiday detection for each item.

PART 2 - PRODUCTS

2.01 Fusion Bonded Epoxy

Lining and coating shall be a one part, thermosetting, heat curing, fusion bonded, dry powder epoxy resin. Fusion bonded epoxy shall be Scotchkote 134 or 206N, as manufactured by 3M, or equal. Fusion bonded epoxy shall be ANSI/NSF 61 certified, for use with potable water.

2.02 Fusion Bonded Epoxy Requirements

Fusion bonded epoxy shall meet, as a minimum, the following requirements:

- | | | |
|----|---|--------------------------|
| A. | Dry Film Thickness: | 16 mils (minimum) |
| B. | Adhesion (Elcometer): | 3,000 psi (minimum) |
| C. | Shear Adhesion (ASTM D1002): | 4,300 psi (minimum) |
| D. | Impact (Gardner 5/8 inch radius tester): | 100 in-lbs (minimum) |
| E. | Hardness (ASTM D2583): | 17 Barcol (minimum) |
| F. | Abrasion Resistance:
(ASTM D4060; 1000g wt. / 5000 cycles) | 0.115g loss (maximum) |
| G. | Penetration (ASTM G17): | 0 % (maximum) |
| H. | Electric Strength (ASTM D149): | 1000 Volts/mil (minimum) |
| I. | Cathodic Disbondment:
(ASTM G8; 30 day, 5 volt, 5% NaCl) | 24 mm dia. (maximum) |

PART 3 - EXECUTION

3.01 Surface Preparation

- A. Grind welds, sharp edges, and surface irregularities, including, but not limited to, weld splatter, slivers, scales, burrs, and gouges to create a smooth surface for application. Welds and sharp edges shall be ground to approximately 1/8 inch radius.
- B. Remove oil and grease in accordance with SSPC-SP1 from surfaces all surfaces to be epoxy lined or coated with an inorganic solvent such as methyl ethyl ketone or toluene. The use of paraffin solvents, such as gasoline or kerosene, is not permitted. There shall not be any residue remaining on the surface from the cleaning solvents. If required, uniformly heat the part to remove excess oil, grease, or moisture.
- C. Surfaces shall be abrasive blast cleaned to NACE No. 2/SSPC-SP10 near-white metal finish. Blasted surfaces shall have a minimum 2 mil anchor pattern. Standards for comparison shall be made available by the Contractor. After abrasive blasting surfaces, remove any residual grit and dust by air blasting.
- D. Apply high temperature masking tapes, liquid release agents, or silicone plugs for threaded holes, as required and as approved by epoxy manufacturer, to protect areas of the parts not required to be epoxy lined and coated.

3.02 Application

- A. Powder shall be applied to parts by means of a fluid bed, flock spray, or electrostatic spray.
- B. Powder shall be applied to parts as soon as possible after surface preparation is complete to prevent the formation of rust blooms. If rust blooms form, the parts shall be re-blasted in accordance with Part 3.01 Surface Preparation, herein.
- C. Parts to be epoxy lined and coated shall be preheated per manufacturer's printed instructions for the furnished epoxy material. Parts shall be heated uniformly. Heat shall not vary more than 10°F in any part of the oven.
- D. Epoxy powder shall be applied in strict accordance with the coating manufacturer's printed instructions for the furnished epoxy material.
- E. Epoxy powder shall be applied within specified gel time and before the parts cool to below the melting point temperature of the epoxy powder.
- F. Applying a second coat of epoxy over a fully cured coat of epoxy shall not be permitted.
- G. Fusion bonded epoxy lining and coating finished uniform dry thickness shall be 16 mils (minimum).
- H. Fusion bonded epoxy shall be cured in accordance with manufacturer's printed instructions for furnished epoxy material. Post bake fusion bonded epoxy lined and coated parts as required to complete curing process.

3.03 Quality

Fusion bonded epoxy lining and coating finished surfaces shall be smooth and consistent, free of a granular finish, pinholes, blisters, cracks, bubbles, voids, mechanical damage, discontinuities, holidays, or any other imperfections.

3.04 Testing

- A. Fusion bonded epoxy lined and coated parts shall be visually and electrically inspected for flaws and damages. Electrical inspection shall consist of a low-voltage wet sponge holiday detector.
- B. Fusion bonded epoxy lined and coated parts shall be tested for thickness electrically by means of an Eddy Current Gauge or magnetically by means of a Magnetic Flux Gauge.
- C. Surface preparation (sandblast) and coating application shall be inspected by an independent third party NACE licensed coating inspector. All costs for third party inspection shall be paid by the Contractor. Thickness and holiday testing shall be performed as well as required corrective work. Certified inspection test reports shall be submitted to the Owner for approval a minimum of two weeks prior to shipment of the materials to the jobsite. Owner shall be able to communicate directly with the coating inspector.

- D. Precautions shall be taken during shipping and handling to protect linings and coatings.

3.05 Repairs

- A. All defects shall be repaired with manufacturer approved repair materials and procedures to match furnished epoxy material.
- B. Unless specified otherwise, fusion bonded epoxy lined and/or coated piping damaged in the field by cutting or welding, shall be returned to the coating applicator for shop repair with fusion bonded epoxy material.

END OF SECTION

SECTION 11005
GENERAL MECHANICAL AND EQUIPMENT
TECHNICAL SPECIFICATIONS

PART 1 - GENERAL

1.01 Description

- A. These General Mechanical and Equipment Specifications, which apply to all systems and equipment unless specified otherwise in the equipment Technical Specifications or on the Drawings, are hereby made a part of each and all of the separate Sections of this Specification. Contractor shall direct the attention of all subcontractors and suppliers of mechanical and related appurtenances to the provisions of the Contract Documents and this Section.
- B. The Contractor shall provide all tools, supplies, materials, equipment, and all labor necessary for the furnishing, construction, installation, testing, and operation of all equipment and appurtenant work, complete and operable, all in accordance with the requirements of the Contract Documents.

1.02 Submittals

A. Shop Drawings

The Contractor shall furnish complete shop drawings for all equipment specified in the various Sections of the specifications and the Construction Drawings, together with all piping, valves, and controls for review by the Owner in accordance with Specification Section 01300.

B. Lateral Design Data

Submit with the shop drawings, details of constructions, and method of attachment for all manufactured products showing compliance with Paragraph 3.04, "Lateral Design and Restraint". Where specified in the Special Requirements, Special Construction Provisions, or Technical Specifications for certain equipment, calculations and details signed by a Professional Engineer who has demonstrated proficiency in Structural Engineering or Civil Engineering and is registered in the State of California shall be submitted. The calculations shall be performed specifically for this project, during the time frame of the project and be dated by the Engineer performing them.

C. Tools

The Contractor shall supply one complete set of special wrenches or other special tools necessary for the assembly, adjustment, and dismantling of the equipment. All tools shall be of best quality hardened steel forgings with bright, finished heads and with work faces dressed to fit nuts. The set of tools shall be neatly mounted in a labeled tool box of suitable design provided with a hinged cover.

D. Operation and Maintenance Manuals

Prepare and submit manuals covering all mechanical equipment and machinery and its electrical components in accordance with Contractor Submittals Technical Specifications.

E. Manufacturer's Certified Reports

Each equipment manufacturer, or his authorized representative, shall submit a written report stating that equipment is ready for start-up and interim operation, and a subsequent written report certifying that the equipment has been properly installed, lubricated, aligned, started-up, tested, adjusted, and operated over the equipment range (full to minimum load, speed, range); the equipment is free from any undue stress imposed by connecting piping or anchor bolts, and is ready for operation by the Owner; equipment is safe to operate and that the equipment is fully covered under the terms of the guarantee. Note that interim operation of equipment may be necessary to provide required treatment or suitable plant operation.

F. Contractor's Certification Reports

Contractor shall submit a written certification along with the manufacturer's certification for start-up and interim operation that he has examined subject equipment and confirms that it is ready for start-up and interim operation and is safe to operate.

Contractor shall submit written certification for relocated, modified, temporarily installed Owner's equipment or Contractor furnished equipment that has been installed for interim operation by the Owner stating that said equipment has been started-up, is ready for operation and is safe to operate.

G. Lifting Recommendations

Each manufacturer shall provide details for proper lifting of equipment and materials during unloading, handling, and installation. Means of lifting equipment shall not impose any undue stress to the equipment. Contractor shall strictly adhere to said manufacturers recommendations.

H. Storage Requirements

Each manufacturer shall provide details and storage of equipment and materials for protection under the specific conditions of the project site, such as rain, snow, freezing, windy, wind blown sand, high temperatures, direct sunlight, etc.

1.03 Quality

A. Factory Inspection

The Owner or its representative may inspect fabricated equipment at the factory without cost to Contractor. The Contractor shall notify the Owner in sufficient time so that factory inspection can be arranged. Factory inspection will be made after manufacturer has performed satisfactory checks, adjustments, tests and operations. Approval of

equipment at the factory only allows the manufacturer to ship the equipment to the site, and does not constitute final acceptance by the Owner.

B. Standard of Quality

Items of equipment are specified by performance and by name of a manufacturer for the purpose of establishing a standard of quality and acceptable experience. Where "or equal" or "approved equal" is specified Substitute equipment will be acceptable if it can be demonstrated to the Owner that the substitute is in strict accordance with the Specifications and equal in quality to those models specifically named. Substitutions shall be submitted in accordance with Contractor Submittals Technical Specifications. Manufacturers specified have been determined by the Owner to meet or exceed the minimum acceptable standard for the designated equipment; however, manufacturer's standard model may require optional equipment, upgrade or modification to meet the intent and requirements of the specifications. All mechanical equipment furnished under this Specification shall be new and of current design.

C. Manufacturer's Experience

Unless specifically named in the detailed Specifications, a manufacturer shall have furnished equipment of the type and size specified which has demonstrated successful operation and is in regular use.

D. Field Inspection, Start-up, and Adjustment

The Contractor shall demonstrate that all equipment meets the specified performance requirements. Contractor shall provide the services of an experienced, competent, and authorized service representative of the manufacturer of each item of major equipment who shall visit the site of Work to perform the following tasks:

1. Assist the Contractor in the installation of the equipment.
2. To inspect, check, adjust if necessary and approve the equipment installation.
3. To start-up and field-test the equipment for proper operation, efficiency, and capacity and to assure that equipment is ready and safe to operate.
4. To perform necessary field adjustment during the test period until the equipment installation and operation are satisfactory to the Owner.
5. To instruct the Owner's personnel in the operation and maintenance of the equipment. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.

E. Costs

The costs of all inspection, start-up, testing, adjustment, and instruction work performed by said factory-trained representatives shall be borne by the Contractor. When available, the Owner's operating personnel will provide assistance in the field testing.

1.04 Equipment

A. General

All equipment furnished shall be complete, ready for installation and operation. All bolts, nuts, washers, mounting plates, bed plates, bases, anchor bolts and other miscellaneous items necessary to form a complete, installed, operational system shall be furnished whether specifically specified or not.

B. Conditions of Service

All equipment shall be capable of operating over the full range specified under the project site environmental conditions including altitude, temperature, relative humidity, freezing, or windy condition as shown on the Drawings or specified in the Special Requirements.

C. Adaptation of Equipment

No responsibility for alteration of a planned structure to accommodate substitute equipment will be assumed by the Owner. Equipment which requires alteration of the structures will be considered only if the Contractor assumes all responsibility for making and coordinating all necessary alterations. All revisions to structures, mechanical, electrical, or other work made necessary by such substitution shall be approved by the Owner and the cost of said revisions, including cost of redesign, shall be made at the Contractor's expense.

D. Motors

Ratings specified and/or shown for the proposed equipment are in accordance with the best information available to the Owner. In the event any equipment item proposed by the Contractor should require motors with larger horsepower rating than indicated on Electrical Drawings, it shall be the Contractor's responsibility to provide the proper control equipment, required modifications to motor control centers, starting equipment, feeder and branch circuits, and accessories as required to make the installation comply with the electrical code and to prevent excessive voltage drop without added cost to the Owner.

E. Match Equipment and Driver

Equipment shall be matched such that the motor rating meets or exceeds the driven equipment requirements (over its full operating range) and the motor controller, switchgear, variable speed drive, etc. meets or exceeds the motor requirements. Where the motor controller or variable speed drive will induce additional heat or otherwise cause derating of the motor, the motor shall be oversized accordingly.

F. Existing Equipment

Where equipment to be furnished is installed in an existing enclosure or adjacent to existing equipment, the Contractor shall field check the dimensions of existing

equipment, location of conduits, etc., and shall familiarize himself with all existing conditions and difficulties to be encountered in performing such work.

1.05 Guarantee and Warranties

The Contractor shall guarantee all equipment in accordance with the conditions of the Contract Documents and as specified in the Contract Appendix or Special Requirements. In addition to the general guarantee requirements, equipment guarantee shall cover faulty or inadequate design; improper assembly or erection; defective workmanship or materials; and leakage, breakage, or other failure. For equipment bearing a manufacturer's warranty in excess of one (1) year, furnish a copy of the warranty to Owner with Owner named as beneficiary.

PART 2 - PRODUCTS

2.01 General Requirements

A. Materials and Workmanship

All equipment furnished shall be new and guaranteed free from defects in materials, design, and workmanship. It shall be the manufacturer's responsibility to ascertain the conditions and service under which the equipment will operate and to warrant that operation under those conditions shall be successful. All parts of the equipment shall be amply proportioned for all stresses that may occur during fabrication, erection, and intermittent or continuous operation.

B. Standards

All equipment shall be designed, fabricated, and assembled in accordance with the best modern engineering and shop practice. Individual parts shall be manufactured to standard sizes and gages so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests. Materials shall be suitable for service conditions. Iron castings shall be tough, close-grained gray iron free from blowholes, flaws, or excessive shrinkage and shall conform to ASTM A48. Except where otherwise specified, structural and miscellaneous fabricated steel used in items of equipment shall conform to the Standards of the American Institute of Steel Construction. All structural members shall be considered as subject to shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall have a minimum nominal thickness of 1/4-inch. Provide equipment and materials suitable for the service conditions and meeting standard specifications such as ANSI, ASME, AWWA, ASTM, NEMA, CBC and UL. The location of the fabricator and his shop schedule shall be furnished to the Owner prior to the beginning of fabrication so that the Owner can schedule shop inspection.

C. Structural Steel Fabrications

Conform to "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" of the AISC unless otherwise indicated or specified. Design all fabrications for dynamic

and vibratory loadings. Use structural steel shapes conforming to ASTM A36, A440, A500, A501, A570, A618, or equal, as applicable. Galvanize specified items in accordance with ASTM A123, A153, or A386 as applicable; use galvanized bolts and fasteners with galvanized assemblies.

D. Welding

Unless otherwise specified or shown, all welding shall conform to the following:

1. All welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Except as modified herein, welding process qualification and operator qualification shall comply with the applicable requirements of the "Code for Arc and Gas Welding in Building Construction" of the AWS.
2. Latest revision of ANSI/AWWA D100 and AWWA C206.
3. Each weld shall be uniform in width and size throughout its entire length. Each layer shall be smooth, free from slag, cracks, pinholes, and undercut and shall be completely fused to adjacent weld beads and base metal. Cover pass shall be completely free of coarse ripples, irregular surfaces, non-uniform bead pattern, high crown, deep ridges or valleys between beads, and shall blend smoothly and gradually into surface of base metal. Butt welds shall be slightly convex, of uniform height, and shall have full penetration. Fillet welds shall be of size indicated, with full throat, and with each leg of equal length. Repair, chipping, or grinding of welds shall not gouge, groove, or reduce base metal thickness.
4. All composite fabricated steel assemblies which are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent entrance of air or moisture.
5. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp corners of material to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

E. Protective Coatings

All equipment shall be painted or coated in accordance with Basic Coating and Painting Specifications for Water and Wastewater Facilities.

F. Protection of Equipment

All equipment including valves shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. All equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, or electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weather tight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers should be avoided, to prevent accumulation of condensate in gears and bearings.

G. Electrical Equipment

Maintain electrical equipment, controls, and keep insulation dry at all times. Keep heaters in equipment connected and operating until equipment is placed in operation.

2.02 Lubrication

A. Lubrication Systems

Lubrication of equipment shall ensure constant presence of lubricant on all wearing surfaces. Lubricant fill and drain openings shall be readily accessible. Easy means for checking the lubricant level shall be provided. Prior to testing and/or operation, the equipment shall receive the prescribed amount and type of lubricant as required by the equipment manufacturer. Equipment lubrication systems shall be systems that require attention no more often than weekly during continuous operation, shall not require attention during start-up or shut down, and shall not waste lubricants.

B. Lubrication

Contractor shall have all moving parts of the furnished equipment lubricated prior to shipment to insure protection against corrosion during shipment, storage, and installation. Lubricants furnished by Contractor shall conform to the manufacturer's printed recommendations. Safeguard(s) shall be provided where necessary to prevent operation of the equipment without proper lubrication.

Contractor shall provide Alemite lubrication fittings at all locations on the equipment which require grease lubrication. All lubrication fittings shall be readily accessible. The grease passages and ports shall be designed so that grease is forced into the normally loaded sides of the bearings.

Contractor shall lubricate all equipment prior to start-up.

Contractor shall furnish grease lubricants for testing and initial lubrication, and for protection of wearing surfaces of equipment he furnishes during shipment and storage. Where lubricants can come in contact with potable water, the lubricant shall not have any toxic or deleterious effect on potable water and shall be of material approved by the FDA in accordance with Federal Regulation No. 121.253, Category AA.

Contractor shall furnish one year's supply of lubrication oils, grease, and other necessary lubricants including applicators and grease guns required for lubrication. All lubricants

shall be as specified by the equipment manufacturer. Contractor shall limit the various types of materials by consolidating, with the equipment manufacturer's approval, the required lubricants into the least number of different lubricants. Contractor shall coordinate with Owner to match, where possible, lubricants normally used by Owner.

2.03 Equipment Supports

A. Equipment Bases and Bedplates

Mount equipment assemblies on a single heavy cast iron or welded steel bedplate unless otherwise shown or specified. Provide bases and bedplates with machined support pads, tapered dowels for alignment or mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits. Continuously weld seams and contact edges between steel plates and shapes, and grind welds smooth. Do not support machinery or piping on bedplates other than that which is factory installed. Provide jacking screws in equipment bases and bedplates to aid in leveling prior to grouting. All mechanical equipment, tanks, control cabinets, motor control centers, etc. shall be mounted on raised concrete bases, unless otherwise shown or specified. Provide plates of minimum thickness of 1/4-inch. Pump bedplates shall include a drip lip and associated piping and appurtenances for directing gland leakage to a single disposal point.

B. Anchors and Sleeves

Each equipment manufacturer shall be responsible to design and specify the required anchor equipment including bolts, nuts, washers, and sleeves for securing equipment bases and bedplates to concrete bases. Loads shall be those induced by the equipment and lateral loads as specified herein. Design calculations are specifically required for certain equipment by the Special Requirements or Technical Specifications. Where specified or where specialty anchoring equipment is necessary for the equipment being furnished the anchoring equipment shall be furnished by the manufacturer. Sleeves shall be at least 1-1/2 times anchor bolt diameter. Anchor bolts shall be as specified on Drawings or, if not specified, shall be Type 316 stainless steel and of adequate length to allow for 1-1/2 inch of grout under baseplates and adequate anchorage into structural concrete unless otherwise shown or specified.

2.04 Couplings

- A. Flexible couplings shall be provided between the driver and the driven equipment to accommodate angular misalignment, parallel misalignment, end float, and to cushion shock loads.
- B. The Contractor shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.
- C. Taperlock bushings may be used to provide for easy installation and removal on shafts of various diameters.
- D. Where universal type couplings are shown they shall be of the needle bearing type construction, equipped with commercial type grease fittings.

2.05 Shafting

A. General

All shafting shall be continuous between bearings and shall be sized to transmit the maximum power output of the driver. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. All shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.

B. Materials

Shafting materials shall be appropriate for the type of service and torque transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as shown or specified unless furnished as part of an equipment assembly.

2.06 Bearings

A. General

Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA). Bearings shall be as specified by the specific equipment specification and as generally specified herein.

Bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and other important factors shall be considered in bearing selection.

All re-lubricatable type bearings shall be equipped with a hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber. All lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.

Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as specified or shown, or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection and disassembly.

Sleeve-type bearings shall have a Babbit or bronze liner.

B. Bearing Life

Except where otherwise specified or shown, all bearings shall have an L-10 minimum rated life expectancy corresponding to the type of service, as follows:

<u>Type of Service</u>	<u>Design Life (years)</u>	<u>L-10 Design Life (hours)</u> (whichever comes first)	
1.	16-hour shift	10	40,000
2.	Continuous	10	60,000

2.07 Gears and Gear Drives

A. Unless otherwise specified, gears shall be machine cut, of the helical or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a minimum service factor of 1.7, a minimum L-10 bearing life of 60,000 hours and a minimum efficiency of 94 percent. Worm gears shall not be used, unless specifically approved by the Owner.

B. All gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, self-cooling, with a breather to allow air to escape but keep dust and dirt out. The casing shall be of cast iron or heavy duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided, arranged for easy reading.

Where the Contractor elects to furnish equipment requiring external cooling by water or radiator he shall be responsible to furnish and install the cooling facilities necessary for proper operation.

C. Gears and gear drives as part of an equipment assembly shall be shipped fully assembled for field installation.

D. Material selections shall be left to the discretion of the manufacturer, provided the above AGMA values are met. Input and output shafts shall be adequately designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have 2 positive seals to prevent oil leakage.

E. Oil level and drain location relative to the mounting arrangement shall be easily accessible. Oil coolers or heat exchangers with all required appurtenances shall be furnished when necessary.

F. Where gear drive input or output shafts have to connect to couplings or sprockets supplied by others, the Contractor shall have the gear drive manufacturer supply matching key taped to the shaft for shipment.

2.08 Safety Guards

All equipment furnished by Contractor shall comply with the applicable requirements of the Safety Orders of the Division of Industrial Safety of the State of California. Copies of the Safety

Orders as available at the Printing Division, Documents Section, State of California, Sacramento, California, 95814.

Cover belt or chain drives, fan blades, couplings, exposed shafts, other moving or rotating parts and hot surfaces (exhaust pipes) on all sides with safety guards. Safety guards shall be free of all sharp edges and corners. Use corrosion-resistant materials at least equivalent to hot-dip galvanized steel. Safety guards shall be fabricated from 16 USS gage, or heavier, galvanized or aluminum-clad steel or 1/2-inch mesh galvanized expanded metal. Design guards for easy installation and removal. Provide necessary supports, accessories, and fasteners, of hot-dip galvanized steel or stainless steel. Design guards in outdoor locations to prevent entrance of rain and dripping water.

2.09 Manufacturer's Nameplates

Manufacturer shall provide Type 316 stainless steel nameplates of ample size with embossed or preprinted lettering, fastened to the equipment in a prominent place with 316 S.S. pins. On nameplates, display manufacturer, serial number, date of manufacture, model number and essential operating characteristics. Inscribe data plates with specific or directed information.

2.10 Equipment Identification Nameplates

In addition to manufacturer's nameplates specified in equipment Technical Specifications and herein, Contractor shall provide project specific equipment identification nameplates. Equipment mounted out-of-doors shall be furnished with nameplates constructed of Type 316 stainless steel with 3/8" high embossed lettering and shall be fastened to the equipment in a prominent place with 316 stainless steel pins.

Equipment mounted indoors shall be furnished with nameplates constructed of laminated engraving plastic. Nameplates shall be fastened to the equipment in a prominent place with 316 stainless steel pins. Colors, lettering, styles, and sizes shall be as selected by Owner.

Nameplates shall display the project specific identification of each equipment item. Proposed nameplate wording shall be submitted to Owner for approval.

PART 3 - EXECUTION

3.01 Coordination

Contractor shall coordinate the installation of equipment and assure compliance with Drawings. Said Drawings show in a diagrammatic form the arrangements desired for the principle apparatus, piping, and similar appurtenances, and shall be followed as closely as possible. Contractor shall take all measurements for his Work at the installation sites, verify all subcontractor and equipment drawings and be responsible for the proper installation. Specific equipment furnished may require certain modifications for installation. Contractor shall have all pertinent equipment shop drawings submitted and accepted by Owner prior to performing work impacted by said equipment.

Contractor shall coordinate, monitor, schedule the fabrication, and verify compliance with Contract Documents of equipment assembled of several components under the unit responsibility

of one manufacturer or equipment supplier. Contractor shall submit the following information to the Owner in writing on a monthly basis:

- A. Shipment dates of the various components to the unit responsibility manufacturers.
- B. Scheduled dates of factory tests by unit responsibility manufacturers.
- C. Schedule shipment dates to site of unit responsibility items.
- D. Scheduled arrival date, installation date and start-up date.

3.02 Installation

A. Inspection

Contractor shall inspect each item of equipment for damage, defects, completeness, and correct operation before installing and inspect previously installed related Work to verify that it is ready for installation of equipment. Contractor shall inspect the completed installation.

B. Preparation

Prior to installing equipment, Contractor shall ensure that installation areas are clean and that concrete or masonry operations are completed. Contractor shall maintain the areas in a broom-clean condition during installation operations. Equipment shall be cleaned, conditioned, and serviced in accordance with Instruction Manuals and the Contract Documents before installing.

C. Certification

Upon completion of equipment installation certifications from the manufacturer and the Contractor in accordance with Part 1.02 shall be submitted.

D. Equipment Installation

Contractor shall employ skilled craftsmen experienced in installation of the types of equipment specified and use specialized tools and equipment, such as precision machinist levels, dial indicators, gages, and micrometers, as applicable.

E. Anchor Bolts

Equipment shall be attached to concrete base using cast in place anchor bolts. Contractor shall set anchor bolts correctly before structural concrete is placed. Use of templates or setting drawings is required. An acceptable anchorage system is a cast in place sleeve anchor which allows adjustment as manufactured by DECO Manufacturing Co. or equal. Deferred bolting devices shall not be permitted, unless otherwise shown on Drawings.

F. Base and Bedplate Grouting

Prior to placing grout, initial fitting and alignment of connected piping shall be completed. Once equipment is leveled and aligned to the manufacturer's tolerances, base or bedplates can be grouted by filling the entire space between the base or bedplate and concrete foundation. Exposed grout, shall be troweled to a smooth dense finish, edges beveled to 45 degrees and damp cured with burlap for three days. When grout is fully hardened, Contractor shall remove jacking screws and tighten nuts on anchor bolts. Equipment alignment and level shall be checked for conformance with manufacturer's tolerances and corrective work performed as necessary.

3.03 Equipment Shop and Field Performance Testing

A. General

Equipment shall be shop tested and field tested as specified in the specific Technical Specifications.

B. Field Testing

Unless otherwise specified field testing of equipment shall be performed to demonstrate compliance with Contract Documents. Equipment operation, over the entire specified range, shall be free of vibration, noise, or cavitation. Contractor shall furnish test instruments required to confirm performance. Testing shall include the following:

1. Vibration shall be checked and recorded over the operating range and shall be equal to or less than the amplitude limits recommended by the manufacturer or as otherwise specified. As a minimum, pumping units shall meet or exceed the vibration requirements of the Hydraulic Institute Standards.
2. Equipment performance shall be documented by obtaining concurrent readings showing motor voltage and amperage, and equipment output. Readings shall be documented for at least three operating conditions. Each power lead to the motor shall be checked for proper current balance.
3. In the event any equipment fails to meet the performance requirements, it shall be modified and retested.

3.04 Lateral Design and Restraint

All manufactured equipment supplied under this Contract shall be designed, constructed and attached to resist stresses produced by seismic forces and wind forces as specified. Equipment that does not vibrate during normal operation shall be rigidly attached. Equipment that vibrates during normal operation shall be attached by means of isolators with mechanical stops that limit movement in all directions unless it can be demonstrated by calculations that such stops are not required. Equipment or portions of equipment that move during normal operation shall be restrained with mechanical devices that prevent displacement unless it can be demonstrated by calculations that such restraints are not required.

A. Calculations shall be submitted where required by the Special Requirements or Technical Specifications.

B. Minimum Lateral Forces

The minimum lateral seismic and wind forces shall be those prescribed for Essential Facilities by the California Building Code and applicable supplements as published by the California Buildings Standards Commission, 2525 Natomas Park Drive, Suite 130, Sacramento, CA 95833. Higher lateral forces shall be utilized where specified.

C. Contractor shall make submittals of shop drawings, details and data requested herein in accordance with Contractor Submittals, Specification Section 01300.

SECTION 11330
SPECIFIC ELECTRIC MOTOR DRIVEN PUMP SPECIFICATIONS
 (THESE SPECIFICATIONS AUGMENT THE
 BASIC ELECTRIC AND PUMPING UNIT SPECIFICATIONS)

1. General

Equipment furnished will be subject to ambient temperatures from 5°F to 120°F, the latter for extended periods, therefore, all equipment shall be capable of operating with said range. Factory performance test as specified shall be performed.

2. Pump (See Basic Pumping Unit Specifications)

a. Performance

Discharge Capacity (gpm)	Bowl Head (Feet)	Minimum Bowl Efficiency	Maximum Brake Horsepower (hp)
0	110' to 115'	N/A	N/A
400	85' to 87'	75%	12
600*	70'	80%	13.5
750	55' to 57'	75%	15

* Design condition.

Preliminary pump selection is based on the following pump manufacturer models:

Manufacturer	Model No.	No. of Stages
Flowserve	10EGY/10EMM	2 Stages

Alternative pumps will be evaluated for acceptability based on the "steepness" of the pump curve between 400 gpm and 700 gpm and the design condition 600 gpm @ 70 ft TDH.

b. Open line shaft (water lubricated), enclosed impeller vertical turbine unit.

c. Horsepower/Speed: The motor is 25 hp, 1780 rpm. The pumping unit shall not exceed 25 brake hp at any point on the entire pump curve inclusive of column, discharge head, and thrust bearing losses. Contractor is notified that the horsepower of the pumping unit is anticipated to be less than is necessary to require a 25 hp motor. The 25 hp motor is specified to provide for future pump upgrades.

d. Discharge head shall be fabricated steel or cast iron with 8" flanged outlet suitable for installation on a 36" sq. x 1-1/2" well top plate. Discharge head shall be designed and constructed to accommodate a 25 hp motor. Contractor shall drill and tap said top plate

to match well discharge head. Head shall be bolted to top plate. Discharge head shall accommodate two-piece top shaft without motor stand(s) or spacer(s).

- e. Maximum Bowl Assembly Diameter: 12"
- f. Number of bowls: Maximum 3
- g. Impeller Type: Enclosed, polished bronze
- h. Column Piping: 230' - 6" nominal, 6.625" O.D., 0.277" wall, 5' top and bottom sections and 6" diameter, 10' suction pipe with galvanized strainer
- i. Line Shaft 1", Type 416 stainless steel line shaft. Contractor shall provide:
 - 1) 2-piece top shaft and coupling
 - 2) Dry run bearings for the upper three (3) bearings
- j. Air Line and Gauge: 1/4" stainless steel tubing set bottom at 230', fastened to column with stainless steel bands at each joint. Gauge shall be 4 1/2" diameter (range 0 to 200' minimum) with fill valve, air line and pressure gauge shall be mounted to pump discharge head with rigid metal bracket
- k. Static Water Level: 9 ft
- l. Pumping Water Level: 24 ft (based on specific capacity listed under Item n. below)
- m. Pump inlet Depth: 235 ft (bowl inlet); 245 ft (suction pipe inlet)
- n. Drawdown: 15 ft (@ 600 gpm; specific capacity 39 gpm/ft)
- o. Well Screen: 16" ID x 3/16" wall (copper bearing steel)
- p. Fluid Pumped: Well water (chemical analysis available upon request), Specific gravity = 1.0

3. Motor

Premium efficiency vertical hollow shaft motor, 25 hp rated, WPI, 4 pole, part-winding, 3-phase, 60 cycle, 480V, 1780 rpm, 1.15 service factor, Design A or B, Class F insulation, thermal protection, motor heater, non-reverse mechanism, and steady bushing.