



Specifications and
Contract Documents for

**Heritage Park Booster
Pump Station & Well House 10**

November, 2024

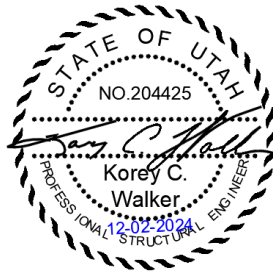
Proposals are due on December 31st at 2:00 PM and shall be sent to Trevor Bell, Budget Division Manager, at tbell@orem.gov. The City will notify all parties after the review panel has evaluated the submissions.



CONTRACT DOCUMENTS
AND SPECIFICATIONS FOR

HERITAGE PARK BOOSTER PUMP STATION & WELL HOUSE 10 PROJECT

December 2, 2024



Signed _____

Project Engineer: Corey Walker
Utah P.E. No. 204424-2203

EPIC ENGINEERING, P.C.
3341 SOUTH 4000 WEST, SUITE A
WEST VALLEY CITY, UTAH 84120

OREM CITY

HERITAGE PARK BOOSTER PUMP STATION & WELL HOUSE 10

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NOTICE INVITING BIDS

Electronic bids for construction of the **Heritage Park Booster Pump Station & Well House #10** will be received on Bidnet Direct until 2:00 p.m. on December 31st, 2024, after which time the proposals will be publicly opened and read aloud. Any bid received after the scheduled closing time for receipt of bids will be returned unopened. Bids will only be accepted by those pre-qualified contractors having received a letter from the City authorizing the contractor to bid the project.

Construction work, in general, consists of the following:

Booster Pump Station: Construction of a 12,000 GPM culinary water booster pump station including an insulated concrete form (ICF) building, vertical turbine pump and motors w/pump cans, pump suction and discharge piping, bridge crane system, heating and ventilation, electrical, standby generator, public restroom facilities.

Well House: Construction of a 5,000 GPM ground well pump station including a concrete masonry unit (CMU) building, vertical turbine pump and motors w/pump can, pump suction and discharge piping, heating and ventilation, electrical, and chlorine injection system & storage.

Site Improvements: Construction of 30-inch welded steel pipe, 36-inch welded steel pipe, 30" welded steel headers, RCP Class III stormwater pipe and catch basins, electrical conduit, potable water and sewer service laterals, curb & gutter, sidewalk, asphalt parking lot, asphalt road restoration on 400 S and 400 W for right-hand turn lane, merging BPS site with Bowen & Collins Booster Tank Site, landscaping for the Booster Tank Site as specified on Bowen & Collins plans, and Booster Pump Station/Well House 10 Site. Installation of bollards surrounding both Well House 10 and Booster Pump Station.

The anticipated substantial completion date for this project will be **November 25th, 2025**.

Electronic copies of the Contract Documents, Specifications and Plans may be requested by emailing Braden Vance at bvance@epiceng.net. Those interested in printed copies of Contract Documents, Specifications and Plans may obtain them from EPIC ENGINEERING upon request at a fee of \$60 per 11" x 17" plan set. A minimum of 24 hours' notice is required to pick up printed copies of the project documents. Acceptable payment options for the above items include cash, cashier's check, or company check. Refunds for Contract Documents, Specifications and Plans will not be made.

Bid security in the form of a certified check, cashier's check or bid bond in the amount of five percent (5%) of the bid shall accompany each proposal.

Orem City reserves the right to reject any or all bids, waive any informality in a bid or to withhold the Award for any reason Orem City determines.

A pre-bid conference will be held at the office of Orem City Public Works, located at 1450 550 North, Orem, UT 84057 on Monday, December 16, 2024 at 1 PM. A site visit to the future Booster Pump Station and Well House 10 location will follow the pre-bid conference.

OREM CITY

Lane Gray
Capital Projects Manager

INFORMATION FOR BIDDERS

SECURING DOCUMENTS

Contract Documents, Specifications and Plans may be procured by emailing Braden Vance at bvance@epiceng.net - Printed copies are available on request for \$60 per 11" x 17" plan set.

SUBMISSION OF BIDS

BIDS will be received by the City of Orem, herein called the "OWNER", electronically submitted using Bidnet Direct or at Development Services until 2:00 pm on Wednesday, November 20th, 2024, and will be downloaded from Bidnet Direct and read aloud. An invitation to bid will be sent to every prequalified contractor.

All BIDS must be made on the required BID form. All blank space for BID prices must be completed in ink or typewritten, and the BID form must be fully completed and executed when submitted. Only one copy of the BID form is required.

The OWNER may waive any informalities or minor defects or reject any and all BIDS. Any BID received after the time and date specified shall not be considered. No BIDDER may withdraw a BID within 60 days after the actual date of the bid opening.

PROPOSAL

Bids to receive consideration shall be made in accordance with the following instructions:

Before submitting a bid, bidders shall carefully read the Plans and Specifications, visit the site of the work, fully inform themselves as to all existing conditions and limitations, and shall include sums in the bid covering the cost of each item included in the Contract. Submission of a Proposal shall be considered prima facie evidence that the bidder has made such examination and is satisfied as to the conditions to be encountered in performing the work and as to the requirements of the Plans, Specifications, and other Contract Documents.

Bids shall be properly executed upon the Proposal attached to and made part of these Contract Documents. Numbers shall be stated both in writing and in figures where so required, and the signatures of all persons signing shall be in longhand. The completed forms shall be without interlineations, alterations, or erasures. In case of a difference in written words and figures in a Proposal, the amount stated in written words shall govern unless obviously in error.

Bids shall not contain any recapitulations of the work to be done. Alternative proposals will not be considered unless called for. No oral, telegraphic, telephonic, or modified proposals will be considered.

All bids shall be made in accordance with applicable statutes of the State of Utah, applicable local laws, and as specified in this Book of Specifications.

BID SECURITY

Each Proposal shall be accompanied by a certified check, cashier's check, or bid bond acceptable to the Owner in an amount equal to at least five percent (5%) of the Proposal, payable without condition to the

Owner as a guarantee that the bidder, if awarded the Contract, will promptly execute such Contract in accordance with the Proposal and in manner and form required by these Contract Documents and will furnish good and sufficient bond for the faithful performance of the same. The bid securities of the three (3) lowest bidders will be retained until the Contract is signed and satisfactory bonds furnished, or other disposition made thereof. The bid securities of all bidders except the three (3) lowest will be returned promptly after the canvass of bids.

EXPERIENCE AND BUSINESS STANDING

Experience and business standing requirements are satisfied by the pre-qualification process for this project.

COMPETENCY OF BIDDERS

Competency of will primarily be evaluated through the pre-qualification process for this project. No bid for the work will be accepted from a Contractor who does not hold an active Contractor's license in good standing applicable to the type of work bid upon at the time of opening bids. Additionally, after an award of the contract, no substitution of the Project Superintendent will be allowed without the written approval by the Owner.

WITHDRAWAL OF BID

Any bidder may withdraw his bid, either personally or by telegraphic or written request, at any time prior to the scheduled closing time for receipt of bids.

CONTRACT AND BONDS

The successful bidder, simultaneously with the execution of the Contract, will be required to furnish a Payment Bond in an amount equal to one hundred percent (100%) of the Contract price and a faithful performance Bond in an amount equal to one hundred (100%) of the Contract price. Said Bonds shall be secured from a surety company approved by the U.S. Department of the Treasury (Circular 570, latest edition).

The form of Contract, which the successful bidder as Contractor will be required to execute, and the forms of Bonds which he will be required to furnish are included in the Contract Documents and should be carefully examined by the bidder. The Contract and the Bonds will be executed in three original counter-parts. The Performance Bond shall extend through the warranty period as specified in the General Conditions.

All bidders are required to have payment and performance bonds underwritten by a Surety Company approved by the U.S. Department of the Treasury (Circular 570, latest edition).

INTERPRETATION OF PLANS AND DOCUMENTS

If any person contemplating submitting a bid for the proposed Contract is in doubt as to the true meaning of any part of the Plans, Specifications, or other proposed Contract Documents, or finds discrepancies in or omissions from the Plans or Specifications, he may submit to the Engineer a written request for an interpretation or correction thereof. The person submitting the request will be responsible for its prompt delivery. Any interpretation or correction of the proposed documents will be made only by Addendum duly issued and a copy of such Addendum will be mailed or delivered to each person receiving a set of such documents. The Owner will not be responsible for any other explanations or interpretations of the proposed documents.

ADDENDA

Any Addenda issued during the time of bidding, forming a part of the documents loaned to the bidder for the preparation of his bid, shall be covered in the bid and shall be made a part of the Contract.

EXECUTION OF CONTRACT

The successful bidder shall execute and return the contract to the Owner no later than 10 days after the date of the Notice of Award.

Time is of the essence in this regard.

AWARD OR REJECTION OF BIDS

Owner reserves the right to reject any and all bids, to waive any and all informalities not involving price, time or changes in the work, and the right to disregard all nonconforming, nonresponsive, unbalanced or conditional bids. The Owner further reserves the right to reject the bid of any bidder if Owner believes that it would not be in the best interest of the project to make an award to that bidder, whether because the bid is not responsive or the bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by Owner. Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any bid and to determine the responsibility, qualifications and financial ability of the bidder to perform and furnish the work. If the contract is to be awarded, it will be awarded to the lowest responsible bidder, whose evaluation by Owner indicates to Owner that the award will be in the best interests of the project.

The award, if made, will be within 30 days after the opening of bids.

The award of the contract may be done in the following ways:

1. For all bid schedules
2. For a single bid schedule
3. For a combination of bid schedules

BIDDERS INTERESTED IN MORE THAN ONE BID

No person, firm, or corporation shall be allowed to make, file, or to be interested in more than one (1) bid for the same work unless alternate bids are called for. A person, firm or corporation who has submitted a subproposal to a bidder, or who has quoted prices on materials to a bidder, is not thereby disqualified from submitting a subproposal or quoting prices to other bidders.

ASSIGNMENT OF CONTRACT

No assignment by the Contractor of any contract to be entered into hereunder, or any part thereof, or of funds to be received thereunder by the Contractor, will be recognized by the Owner unless such assignment has had prior approval of the Owner and the Surety has been given due notice of such assignment in writing and has consented thereto in writing.

SPECIAL NOTICE

Bidders are required to inform themselves fully of the conditions relating to construction and labor under which the work will be or is now being performed, and the Contractor must employ, as far as possible, such methods and means in carrying out his work as will not cause any interruption or interference to any other contractor.

PLANS AND SPECIFICATIONS TO SUCCESSFUL BIDDER

The successful bidder may obtain five (4) sets of Plans and Specifications for this project at no extra cost.

If he desires more than the five (4) sets, he may purchase additional sets at the costs listed on page NIB-1 from EPIC ENGINEERING, P.C.

CONSTRUCTION SCHEDULING

It is the intent of the Owner to have the work performed on this project during the 2024 and 2025 calendar years.

The Contractor shall commence work under this Contract on or before the tenth day after receiving written Notice to Proceed from the Engineer on behalf of the Owner and shall fully complete all work under the respective bid schedules by the dates indicated in TIME OF COMPLETION. The Contractor shall at all times during the continuance of the Contract prosecute the work with such force and equipment as are sufficient to complete it within the time segments specified.

TIME OF COMPLETION

The Contractor shall commence work under this Contract on or before the tenth day after receiving written Notice to Proceed from the Engineer on behalf of the Owner and shall fully complete all work under this Contract by August 31st 2025.

NONPERFORMANCE OF WORK TASKS BY THE CONTRACTOR

If the Contractor fails, neglects, or refuses to perform work tasks necessary for the completion of the total job; to replace defective work; or to repair or resurface, in a manner that is acceptable to the Owner and Engineer, public rights-of-way disturbed by his work which are a nuisance, a hazard, or which impedes or endangers vehicular traffic and the public, the Owner may serve written notice upon the Contractor of his intention to have the work performed by others. Unless within three (3) days after the service of such notice, the Contractor has made such arrangement and scheduled the accomplishment of said work tasks to the satisfaction of the Owner and Engineer, the Owner will proceed to have the work accomplished by others and deduct the costs thereof from amounts due the Contractor.

PRE-BID CONFERENCE

There will be no pre-bid conference for this project. Contractors may visit the site whenever they want. Questions about the project can be submitted to the engineer for answering.

PERMITS AND LICENSES

The Contractor shall procure all permits and licenses, pay all charges, fees, and taxes and give all notices necessary and incidental to the due and lawful prosecution of the work.

Bidders shall have a valid contractor's license for the type of work required on this Contract.

Should you desire additional information prior to submitting your bid, please call EPIC ENGINEERING, P.C. in West Valley City, Utah, telephone No. (801) 955-5605, attention: Korey Walker, P.E.

Neither the Engineer nor OREM CITY shall be held responsible for any oral instructions. Any changes to the Plans and Specifications will be in the form of an Addendum which will be furnished to all plan holders.

LIQUIDATED DAMAGES

Liquidated damages shall be five hundred dollars (\$500) per calendar day.

INSTRUCTIONS FOR PREPARING PROPOSAL

BID ITEMS

Payment of the bid price, as stated in the Contractor's Proposal, for the completed work shall be compensation in full for the furnishing of all overhead labor, materials, devices, equipment, and appurtenances included in the work as are necessary to complete the total work under this Contract in a good, neat, and satisfactory manner as indicated on the Plans, as described in the Specifications, and as otherwise implied or required to fulfill the objective of the work. Each item, fixture, piece of equipment, work, etc., as indicated on the Plans, or specified anywhere in these Documents, shall be completed with all necessary connections and appurtenances for the satisfactory use and operation of said item, and the total system or systems.

Any and all patents and license fees for the right to use equipment or processes included in this Contract shall be included in the bid price. The Contractor shall submit to the Engineer an itemized list of all such fees, indicating the amount of each and to whom paid.

Cost of painting, testing, and other incidental operations, profit, and overhead cost, including the cost of supervision, temporary field offices, move-in, move-out, insurance, taxes, equipment not a permanent part of the job, and other incidental items, shall be included in the bid price.

The bid shall be based upon certain manufacturer's items, for which the bidder shall indicate the designated manufacturers in the spaces if provided in the proposal.

If the bidder proposes an alternate manufacturer that has not been named in the Specifications under the item to be designated, the bidder shall, if requested, submit data to the Engineer for review after the bidding and before the Award of the Contract. The equipment proposed to be furnished by the bidder from an alternate manufacturer shall conform to the specific requirements of the bid item, and any one of the specified manufacturers' items shall serve as a standard of quality for the item.

If the equipment proposed to be furnished by the bidder from an alternate manufacturer does not and/or cannot be made, in the opinion of the Engineer, to conform to the Requirements of these Specifications, then the bidder shall furnish the equipment of a manufacturer that does meet these requirements at no extra cost to the Owner.

The Owner may require additional detailed information regarding the equipment which the bidder proposes for certain bid items. If this additional information is requested from the bidder, it must be furnished in complete detail before the Award of the Contract. The information must be in sufficient detail so that the Engineer can evaluate the bidder's Proposal on the items.

All specific requirements of the Specifications must be adhered to, and all necessary modifications shall be made in the article specified by trade name, type, or model of manufacturer's equipment to make it conform to all specific requirements of the Specifications.

If the bidder does not designate a manufacturer for an item of equipment in the allotted space, the Owner will designate a manufacturer from those named in these Specifications for that item of equipment, with no adjustment made in the bid price.

In cases where an item is not listed under designated items of equipment in the Proposal, and where material or equipment is designated on the Plans or in the Specifications by a trade or manufacturer's

name, it is so designated primarily to establish standards of quality, finish, appearance, and performance. It is not the intent to limit the choice of materials and equipment to the specific product designated. Requests relative to substitutions permitted under the conditions provided by this paragraph for materials or equipment specifically designated on the Plans or in the Specifications shall be made in writing, after Award of the Construction Contract, and such requests shall be accompanied by complete data on which the Engineer can make determination on the merits of the proposed substitution. The written request shall state how the product proposed for substitution compares with or differs from the designated product in composition, size, arrangement, performance, etc., and, in addition, the request shall be accompanied by documentary evidence of equality in price and delivery or evidence of difference in price and delivery. Data on price shall be in the form of certified quotations from suppliers of both the designated and proposed items. All items accepted for substitution shall be subject to all applicable provision of the Specifications.

Bids shall not contain any recapitulations of the work to be done. Alternative proposals will not be considered unless called for. No oral, or telephonic modifications or withdrawals of Proposals will be considered.

If anyone is in doubt as to the true meaning of any part of the Plans, Specifications, or other portions of the Contract Documents, or finds discrepancies in, or omissions from the Plans or Specifications, he may submit to the Engineer a request for an interpretation or correction thereof. The person submitting the request will be responsible for its prompt delivery. Any interpretation or correction of the Contract Documents will be made only by an Addendum duly issued and a copy of such Addendum will be mailed or delivered to each person receiving a set of such Documents. The Owner will not be responsible for any other explanation of interpretations of the Documents.

If the Proposal is made by an individual, it shall be signed and his full name and address shall be given; if it is made by a firm, it shall be signed with the co-partnership name by a member of the firm, who shall also sign his own name, and the name and address of each member shall be given; and if it is made by a corporation, the name of the corporation shall be signed by its duly authorized officer or officers.

PROPOSAL

Place: _____
Date: _____

OREM CITY
56 N. State Street
Orem, UT 84057

In compliance with your invitation for bids and all conditions of the Contract Documents for the construction of the Heritage Park Booster Pump Station and Well House #10, the undersigned _____, a corporation organized under the laws of the State of _____, a partnership consisting of _____ or individuals trading as _____ of the City of Orem, hereby proposes and agrees to furnish any and all materials, labor, construction equipment, services, and transportation required for performing all work for the construction described in the NOTICE INVITING BIDS and to construct the same and install the material therein for the Owner in a good and workmanlike and substantial manner acceptable to the Owner, through its Engineer, or his properly authorized agents, and strictly pursuant to and in conformity with the Specifications and Plans prepared by the Engineer for the Owner, and with such modification of the same and other documents that may be made by the Owner through its Engineer or his properly authorized agents, as provided herein, at the following lump sum and unit prices for the work described in the bid schedules.

DESIGNATED ITEMS OF EQUIPMENT

The bid shall include the designated manufacturers as written by the bidder in the spaces provided therefore.

If the bidder does not designate, in the space provided, the name of the equipment manufacturer which has been included in his unit bid price, the Owner will have the right to designate equipment manufacturer of those named in the Specifications or of their choosing, for this item and the bidder shall furnish the equipment from the manufacturer to designated with no adjustment in the unit bid price.

ITEM 1 - CONCRETE

Designated Local Supplier _____

ITEM 2 – ASPHALT PAVEMENT

Designated Local Supplier _____

ITEM 3 – SIDING

Designated Manufacturer ChamClad Color #6046 (6” Classic Wall Panel

Designated Local Supplier Supply Options Recommended

Designated Manufacturer

Designated Supplier

ITEM 15 – BRIDGE CRANE

Designated Manufacturer

American Equipment, or Equal

ITEM 16 – FLOW CONTROL VALVE

Designated manufacturer/model

CLA-VAL 40-01

Designated supplier

ITEM 17 – PRESSURE REDUCING VALVE

Designated manufacturer/model

CLA-VAL 90-01

Designated supplier

BID SCHEDULES “A” AND “B”

The undersigned hereby declares that he has visited the site and has carefully examined the Contract Documents, consisting of one volume, relating to the work covered by the below bids. The bids below, are divided into two (2) separate bid schedules. Bid Schedule “A” covers all costs associated with the construction of the Booster Pump Station. Bid Schedule "B" covers all costs associated with the construction of the Well House #10.

The Bid Security (Certified Check, Cashier's Check, or Bid Bond) attached, payable to the Owner in the sum of not less than five percent (5%) of the lump sum bid for the complete project (Bid Schedule “A” and “B”), is to become the property of the Owner in the event the Contract and Bonds are not executed within the time set forth, as liquidated damages for the delay and additional work caused thereby.

The undersigned hereby declares, as bidder, that the only persons or parties interested in this PROPOSAL as principals are those named herein; that no elected official or employee of the Owner is in any manner interested directly or indirectly in this PROPOSAL or in the profits to be derived from the Contract proposed to be taken, other than as permitted by law; that this bid is made without any connection with any other person or persons making a separate bid for the same purpose; that the bid is in all respects fair and without collusion or fraud; that he has read the NOTICE INVITING BIDS and the INFORMATION FOR BIDDERS hereto attached, and agrees to all the stipulations contained therein; that he has examined the form of Contract attached hereto, and the Specifications, and he proposes and agrees that if his bid as submitted, and as more fully described in the attached sheets, be accepted, he will contract in the form so attached to furnish the items and perform work called for in accordance with the provisions of said form of Contract and the Specifications and to deliver the same within the time stipulated therein; and that he will accept in full payment, therefore, the prices named in this PROPOSAL.

The bidder further agrees that, upon receipt of written notice of the acceptance of this PROPOSAL, within 30 calendar days after the date of opening of the bids, he will execute the Contract in accordance with the PROPOSAL as accepted and furnish the required bond within 10 days from date of mailing of said notice of acceptance to him at his address as given below, or within such additional time as may be allowed by the Owner; and that upon his failure or refusal to do so within said time, then the certified or cashier's check or bid bond accompanying this bid shall be cashed or enforced and the money payable pursuant thereto shall be forfeited to and become the property of the Owner as liquidated damages for such failure or refusal; provided, that if said bidder shall execute the Contract and furnish the required bonds within the aforesaid time, his certified or cashier's check, if furnished, shall be returned to him within three days thereafter, and the bid bond, if furnished, shall become void.

Orem

BID FORM FOR BID SCHEDULE "A"

All applicable sales taxes, State, and/or Federal, and any other special taxes, patent rights, or royalties are included in the price quoted in this Proposal. Figures to be typewritten or clearly and legibly printed in ink. LF is equal to linear-feet, LS is lump sum, SF is equal to square-feet, and CY is equal to cubic yards.

Refer to Measurement and Payment Plan (M&P) for the scope of work of each line item. Prepared by Epic Engineering as of 12/02/2024

#	DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
1	General, Mobilization, and Demobilization (Including Jersey Barrier Site Protection as Req.)	1	LS		
2	Facility Construction (Roof, Exterior Doors, Exterior Walls, Floors & associated appurtenances, lavatory & all associated items, Building siding & installation, Steel reinforcement, Generator Leveling, 14' tall generator yard gate, etc..)	1	LS		
3	Facility Services (All items on interior of BPS wall for Plumbing, HVAC, Electrical, I&C, etc...)	1	LS		
4	BPS Site and Infrastructure (Parking, Exterior Concrete, Bollards & all associated improvements & connections required to add into site, Site Mechanical: All piping & conduit on exterior of BPS wall for elec., sewer, water lines, storm drains, small piping with exception of sprinkler system, etc.)	1	LS		
5	Process Equipment (Crane, etc...)	1	LS		
6	Landscaping (Landscaping for BPS Site & Booster Tank Tie-in & all associated improvements & connections required to maintain surface improvements, sprinkler system and all required connections for both BPS site and Booster Tank Site, etc...)	1	LS		
7	400 South Asphalt Restoration & Striping (Asphalt in 2 lifts – 3" base layer where req, 2" finishing layer over extents, lifting manholes & valves to surface + addition of concrete collars around each valve/manhole, all other associated improvements/connections required to perform asphalt restoration and striping – striping plan to be provided by Orem at later date, etc...)	1	LS		

	SUBTOTAL BID (ITEMS # 1 – 7)	
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Bidder is cautioned to read carefully the INFORMATION FOR BIDDERS Section of these Contract Documents and the INSTRUCTIONS FOR PREPARING PROPOSAL relating to what is to be furnished under each item of the PROPOSAL and to submittal of bid.

Bidder understands and agrees that the Owner reserves the right to reject any or all bids and to waive any informalities in the bidding.

The bidder agrees that this bid shall be good and may not be withdrawn for a period of 60 calendar days after the scheduled closing time for receiving bids. Bidder acknowledges receipt of the following addenda:

The undersigned bidder shall acknowledge receipt of the following addenda, if any.
Addenda No(s). _____ .

Respectfully submitted,

Bidder

By _____

Title

(Corporate Seal)
If bid is by corporation

Witness: if bidder is an individual

Bidder's post office address:

Bidder's street address:

Bidder's phone number:

Name and address of all members of
the firm or names and titles of all
officers of the corporation:

SEAL

**MEASUREMENT & PAYMENT PLAN
BID SCHEDULE “A”**

PART 1 - GENERAL

1.1 SUMMARY

- A. Work covered by this section includes method of measurement and basis of payment for all sections included.
- B. All measurements and payments will be based on completed and accepted work performed in accordance with the drawings and specifications.
- C. Payment shall be full compensation to complete the work items in good faith, including incidental work.
- D. Payment will be made only for completed work at the contract unit price based.
- E. Payment under each line item shall be full compensation for the following:
 - 1. labor
 - 2. materials
 - 3. equipment
 - 4. tools
 - 5. testing
 - 6. subcontracts and services
 - 7. Quality control testing of materials

PART 2 - BID ITEMS – BASE BID

2.1 BID ITEM NO. 1 – Mobilization/Demobilization

- A. Measurement: Payment will be made at the contract lump sum price.
 - a. Progress payment shall be made as follows:
 - 1) When 5 percent or more of the original contract amount is earned from other pay items, 50 percent of the amount for mobilization/demobilization, or 5 percent of the original contract amount, whichever is less, shall be paid.
 - 2) Upon completion of all work on the project, any unpaid amount for mobilization/demobilization shall be paid.
- B. For Reference Specs Divisions:
 - General Requirements
- C. Basis of Payment: Lump sum compensation is given to cover all preparatory work and operations necessary for the movement of personnel, equipment, supplies, and incidentals to and from the job site and to cover the cost of permits and bonds and for all other work and operations that must be performed or cause cost to be incurred prior to beginning work on the various items on the project site. These include the Quality Control Plan, Stormwater Pollution Prevention Plan,

temporary utilities, and project supervision. Coordination with Engineering firm to perform construction staking. Bids obviously unbalanced in favor of this item will be considered non-responsive.

2.2 BID ITEM NO. 2 – FACILITY CONSTRUCTION

- A. Basis of Measurement: Lump Sum.
- B. For Reference Specs Divisions:
 - Existing Conditions
 - Concrete
 - Masonry
 - Metals
 - Wood, Plastics, and Composites
 - Thermal and Moisture Protection
 - Openings
 - Finishes
 - Specialties
 - Equipment
 - Furnishings
 - Special Construction
 - Conveying Equipment
- C. Basis for Payment: Payment shall cover the cost of labor, tools, equipment, and material, and performing all operations in connection with installation of concrete slabs, concrete vault, CMU walls, metal stairs, steel beams, wood trusses, metal roof, gutters, downspouts, doors, skylights, sheathing, wallboard, paint, steeples, fire alarm system and providing of record drawings (as-builts), testing, and all other appurtenances.

2.3 BID ITEM NO. 3 – FACILITY SERVICES

- A. Basis of Measurement: Lump Sum.
- B. For Reference Specs Divisions:
 - Fire Suppression
 - Plumbing
 - Heating, Ventilating, and Air Conditioning (HVAC)
 - Reserved for Future Expansion
 - Integrated Automation
 - Electrical
 - Communications
 - Electronic Safety and Security
- C. Basis for Payment: Payment shall cover the cost of labor, tools, equipment, and material, and performing all operations in connection with installation of pipe supports, facility water, sanitary sewer, storm sewer, vertical turbine pumps, steel pipes, HVAC, chlorine analyzer, electrical,

Motor Control Center, transformers, lighting, communication systems, instrumentation, and controls. Includes providing record drawings (as-builts), testing, and all other appurtenances.

2.4 BID ITEM NO. 4 – SITE AND INFRASTRUCTURE

- A. Measurement: Lump Sum.
- B. For Reference Specs Divisions:
 - Earthwork
 - Exterior Improvements
 - Utilities
 - Transportation
- C. Basis for Payment: Payment shall cover the cost of labor, tools, equipment, and material, and performing all operations in connection with excavating, backfill, compaction, shoring, parking lot, curbs, gutters, sidewalks, fencing, gates, transformers, exterior utilities (water, sewer, electrical, etc...), manholes, and cleanouts. Includes providing record drawings (as-builts), testing, and all other appurtenances.

2.5 BID ITEM NO. 5 – PROCESS EQUIPMENT

- A. Basis of Measurement: Lump Sum.
- B. For Reference Specs Divisions:
 - Process Interconnections
 - Material Processing and Handling Equipment
 - Process Heating, Cooling, and Drying Equipment
 - Process Gas and Liquid Handling, Purification, and Storage Equipment
 - Pollution and Waste Control Equipment
 - Industry-Specific Manufacturing Equipment
 - Water and Wastewater Equipment
 - Electrical Power Generation
- C. Basis for Payment: Payment shall cover the cost of labor, tools, equipment, and material, and performing all operations in connection with installation of gantry crane. Generator and transfer switch shall be provided and installed by others. Includes cost of contractor coordinating and cooperating with generator installation. Includes providing record drawings (as-builts), testing, and all other appurtenances.

2.6 BID ITEM NO. 6 – LANDSCAPING

- A. Basis of Measurement: Lump Sum.
- B. For Reference Specs Divisions:
 - Existing Conditions
 - Earthwork
 - Concrete

- Finishes
- Electrical
- Exterior Improvements
- Utilities

Basis for Payment: Payment shall cover the cost of labor, tools, equipment, and material, and performing all operations in connection with the landscaping on both the Ex. Booster Tank site section as called out by Bowen & Collins/Epic Engineering, and the Booster Pump Station/Well House 10 Site. Landscaping cost shall include installation of a sprinkler system, landscaping, RPZ setup, etc. Includes providing record drawings (as-builts), testing, and all other appurtenances

2.7 BID ITEM NO. 7 – 400 SOUTH ASPHALT RESTORATION & PAINT STRIPING

A. Basis of Measurement: Lump Sum.

B. For Reference Specs Divisions:

- Earthwork
- Exterior Improvements
- Utilities
- Transportation

C. Basis for Payment: Payment shall cover the cost of labor, tools, equipment, and material, and performing all operations in connection with preparation of roadway for asphalt paving, asphalt paving, roadway finishing, including striping and installation of concrete collars around each manhole and valve in roadway. Includes cost of contractor coordinating and cooperating with City & Engineer for striping plan (will be issued later), and the design & implementation of traffic control. Includes providing record drawings (as-builts), testing, and all other appurtenances.

BID FORM FOR BID SCHEDULE “B”

All applicable sales taxes, State, and/or Federal, and any other special taxes, patent rights, or royalties are included in the price quoted in this Proposal. Figures to be typewritten or clearly and legibly printed in ink. LF is equal to linear-feet, LS is lump sum, SF is equal to square-feet and CY is equal to cubic-yards.

City of Orem - Well House #10

Bid Item	Description	Qty	Unit	Unit Bid Amount	Total Bid Amount
1	Mobilization/Demobilization	1	LS		\$
2	Construction Surveying	1	LS		\$
3	Storm Water Control	1	LS		\$
4	Materials Testing	1	LS		\$
5	Clearing, Grubbing, and Stripping	1	LS		\$
6	Potholing	1	LS		\$
7	Well House Structure	1	LS		\$
8	Service Connection to Existing City Drinking Water Meter	1	LS		\$
9	Site Grading	1	LS		\$
10	Excavation, Backfill, and Compaction Under Well House	1	LS		\$
11	Furnish and Install Pump and Motor Assembly Complete	1	LS		\$
12	Well House Internal Piping Complete	1	LS		\$
13	Pump to Waste Box and Piping Complete	1	LS		\$
14	Chlorination System Complete	1	LS		\$
15	Electrical System Complete	1	LS		\$
16	HVAC System Complete	1	LS		\$
17	16-Inch Discharge Pipeline, Valves, and Fittings Complete	30	LF		\$
18	Sidewalk and Bollards	890	SF		\$
19	Testing and Commissioning	1	LS		\$
BID SCHEDULE TOTAL				\$	

MEASUREMENT AND PAYMENT BID SCHEDULE "B"

GENERAL

All work completed under this contract shall be in accordance with the Contract Drawings and Specifications and will be measured by ENGINEER/OWNER. The quantities appearing on the Bid Schedule are approximate only and are prepared for the comparison of bids. Payment to CONTRACTOR on bid items with unit prices other than "Lump Sum" will be made for actual quantities of work performed and accepted, or material furnished in accordance with the Contract. The scheduled quantities of work to be done and materials to be furnished may be increased or decreased in accordance with the General Conditions.

The term "Lump Sum" when used as an item of payment will mean complete payment for the work described in the contract. When a complete structure, portion of work, or unit is specified "Lump Sum" as the unit of measurement, the unit will include fittings, accessories, and all work necessary to complete the work as shown on the Drawings and as specified.

When the accepted quantities of work vary from the quantities in the Bid Schedule, CONTRACTOR shall accept as payment in full, so far as contract items are concerned, payment at the original contract unit prices for the work done. OWNER reserves the right to add to or delete from quantities listed in the bid schedule in order to match the total bid with the budgeted money available.

BASE BID SCHEDULE

BID ITEM NO. 1 – "MOBILIZATION/DEMOBILIZATION"

GENERAL This bid item is provided to cover CONTRACTOR's cost for general and miscellaneous responsibilities and operations not normally attributed to any other single bid item within this schedule. This shall include, but is not limited to, work described or enumerated in Section 01 71 13 - Mobilization.

METHOD OF MEASUREMENT "Mobilization/Demobilization" shall not be measured, but shall be paid for on a lump sum basis for the completion of the work as required in Section 01 71 13 - Mobilization.

BASIS OF PAYMENT Payment for "Mobilization/Demobilization" will be made at the contract lump sum bid price. Payments will be made in accordance with the following schedule:

When 10% of the original contract amount is earned, 25% of the amount bid for mobilization will be paid.

When 25% of the original contract amount is earned, an additional 25% for a total of 50% of the amount bid for mobilization will be paid.

When 50% of the original contract amount is earned, an additional 25% for a total of 75% of the amount bid for mobilization will be paid.

When 75% of the original contract amount is earned, an additional 25% for a total of 100% of the amount bid for mobilization will be paid.

BID ITEM NO. 2 – "CONSTRUCTION SURVEYING"

METHOD OF MEASUREMENT "Construction Surveying" shall not be measured but shall be paid for on a lump sum basis for the acceptable completion of the work.

BASIS OF PAYMENT Payment for this item shall be on a lump sum basis. Payment shall be considered complete compensation for all labor, equipment, and materials, necessary to perform the work. Payment includes marking in the field the locations of facilities to be constructed and includes staking offsets as needed, vertical datum bench marks and a horizontal control network for the contractor. Payment also includes a certified record survey which includes the location of all new facilities.

BID ITEM NO. 3 – "STORM WATER CONTROL"

METHOD OF MEASUREMENT This bid item shall not be measured but shall be paid for on a lump sum basis to develop and implement a Storm Water Pollution Prevention Plan (SWPPP) for construction of the project.

BASIS OF PAYMENT Payment for this item will be made at the contract lump sum bid price and shall be considered complete compensation for all labor, equipment, and materials to develop a SWPPP in accordance with Orem City standards, to submit the SWPPP to Orem City for review, and implement the SWPPP throughout the construction of the project. Payments will be made in accordance with the following schedule:

When 10% of the original contract amount is earned, 25% of the amount bid for this item will be paid.

When 25% of the original contract amount is earned, an additional 25% for a total of 50% of the amount bid for this item will be paid.

When 50% of the original contract amount is earned, an additional 25% for a total of 75% of the amount bid for this item will be paid.

When 75% of the original contract amount is earned, an additional 25% for a total of 100% of the amount bid for this item will be paid.

BID ITEM NO. 4 – "MATERIALS TESTING"

GENERAL This bid item is provided to cover CONTRACTOR's cost for general and miscellaneous responsibilities and operations associated with quality control and materials testing.

METHOD OF MEASUREMENT "Materials Testing" shall not be measured but shall be paid for on a lump sum basis for the completion of the work

BASIS OF PAYMENT Payment will be made at the contract lump sum bid price. Payments will be made in accordance with the following schedule:

When 10% of the original contract amount is earned, 25% of the amount bid for this item will be paid.

When 25% of the original contract amount is earned, an additional 25% for a total of 50% of the amount bid for this item will be paid.

When 50% of the original contract amount is earned, an additional 25% for a total of 75% of the amount bid for this item will be paid.

When 75% of the original contract amount is earned, an additional 25% for a total of 100% of the amount bid for this item will be paid.

BID ITEM NO. 5 – "CLEARING, GRUBBING, AND STRIPPING"

GENERAL This bid item is intended to cover the CONTRACTOR's cost for general and miscellaneous responsibilities and operations associated with Clearing, Grubbing and Stripping. This shall include, but is not limited to work described or enumerated in 31 11 00 – Clearing, Grubbing, and Stripping.

METHOD OF MEASUREMENT "Clearing, Grubbing, and Stripping" shall not be measured, but shall be paid for on a lump sum basis for the cost of the Clearing, Grubbing, and Stripping necessary for the preparation of the construction site for the well house as shown on the Contract Drawings.

BASIS OF PAYMENT Payment for "Clearing, Grubbing, and Stripping" shall be made at the contract lump sum bid price for the completion of all Clearing, Grubbing, and Stripping required to prepare the site for the construction of the well house as shown on the Contract Drawings.

BID ITEM NO. 6 – "POTHOLING"

METHOD OF MEASUREMENT "Potholing" shall not be measured, but shall be paid for on a lump sum basis to locate major utility crossing or connection, as shown on the Contract Drawings.

BASIS OF PAYMENT Payment for "Potholing" shall be made at the contract unit lump sum bid price to locate all points where pipelines, or other utilities, tie into existing

infrastructure, or to avoid damage to or conflicts with existing infrastructure. Payment shall be considered complete compensation for all labor, equipment and materials including, but not limited to, excavation, backfill; untreated base course, compaction; restoration of all surface improvements including but not limited to asphalt patch, sidewalk, curb and gutter, and landscaping where applicable, and all other items require to complete this item as shown on the Contract Drawings and specified herein. Measure the depth from the ground to the top of pipe and provide the depth to ENGINEER for each utility potholed.

BID ITEM NO. 7 – "WELL HOUSE STRUCTURE"

METHOD OF MEASUREMENT "Well House Structure" shall not be measured, but shall be paid for on a lump sum basis for furnishing and constructing the structure for the well house as required in the Contract Drawings and Specifications.

BASIS OF PAYMENT Payment for "Well House Structure" shall be made at the contract unit lump sum bid price for completion of the structure as shown on the Contract Drawings and specified herein. Payment shall include, but not be limited to, furnishing all labor, materials, and equipment necessary for constructing the concrete and concrete masonry unit structure. Payment shall include, excavation, dewatering, furnishing and installing all steel reinforcement, forms, and concrete for foundations, walls, and slabs, pump access hatch, man doors, coating; concrete equipment pads, pump room, interior sound wall and sound control, chlorine room concrete pump pedestals; trench drain grating; and miscellaneous items to complete the structure of the well house as shown on the Contract Drawings and specified herein and other related items not paid elsewhere for a complete wellhouse structure.

BID ITEM NO. 8 – "SERVICE CONNECTION TO EXISTING CITY DRINKING WATER METER"

METHOD OF MEASUREMENT This bid item shall not be measured but shall be paid for on a lump sum basis for completion of the service connection to the existing drinking water meter.

BASIS OF PAYMENT Payment for this item shall be on a lump sum basis. Payment shall be considered complete compensation for all labor, equipment, and materials, necessary to construct and connect the service connection to the existing drinking water meter as shown on the Contract Drawings and as specified herein. Payment shall include excavation, backfill, compaction furnishing and installing pipe, fittings, tracer tape, tracer wire and all other items necessary to complete this item.

BID ITEM NO. 9 – "SITE GRADING"

METHOD OF MEASUREMENT “Site Grading” shall not be measured but shall be paid for on a lump sum basis and shall include grading necessary to construct the new well house.

BASIS OF PAYMENT Payment for “Site Grading” shall be made at the contract lump sum bid price and shall be considered full compensation for all work completed under this bid item. Payment shall include, but not be limited to, all labor, material, and equipment necessary for excavation, furnishing, placing, and compacting approved site fill material, general grading cleanup, and all other incidentals not specifically paid for in other bid items but which are shown or otherwise required to complete the installation as herein described and as shown on the Contract Drawings and specified herein.

BID ITEM NO. 10 – "EXCAVATION, BACKFILL, AND COMPACTION UNDER WELL HOUSE"

METHOD OF MEASUREMENT “Excavation, Backfill, and Compaction Under Well House” shall not be measured, but shall be paid for on a lump sum basis for soil excavation, fill, backfill and compaction for the well house to place footings, foundation, and floor slab.

BASIS OF PAYMENT Payment for “Excavation, Backfill, and Compaction Under Well House” shall be made at the contract unit lump sum bid price and shall be considered complete compensation for all labor, equipment and materials for excavation underneath the well house, and required side slopes as well as the necessary backfill and compaction within this same area. Payment shall include, but not be limited to, all labor, equipment, materials necessary for excavation, furnishing and installing approved backfill material, and compaction of specified structural material as herein described and as shown on the Contract Drawings. All other excavation, backfill and compaction for this project shall be paid for elsewhere.

BID ITEM NO. 11 – "FURNISH AND INSTALL PUMP AND MOTOR ASSEMBLY COMPLETE"

METHOD OF MEASUREMENT “Furnish and Install Pump and Motor Assembly Complete” shall not be measured but shall be paid for on a lump sum basis for furnishing and installing the complete pump assembly according to the amount defined in the Bid Schedule and as completed by CONTRACTOR.

BASIS OF PAYMENT Payment for “Furnish and Install Pump and Motor Assembly Complete” shall be made at the contract lump sum price for complete installation of an acceptable pump assembly. Payment shall include, but not be limited to, all labor, materials, and equipment necessary for furnishing, installing, and testing the pump assembly as shown on the Contract Drawings and as specified herein. Payment shall include, furnishing and installing the modifications to the existing surface conductor

and casing pipes, air vent; sleeves and washers; pump bowls, shafting, pump column, level sensor tube and sounding tube, oil reservoir, discharge head, coatings and linings, motor, testing, and all other related items not paid elsewhere.

BID ITEM NO. 12 – "WELL HOUSE INTERNAL PIPING COMPLETE"

METHOD OF MEASUREMENT "Well House Internal Piping Complete" shall not be measured but shall be paid for on a lump sum basis according to the amount defined in the bid schedule.

BASIS OF PAYMENT Payment for "Well House Internal Piping Complete" shall be paid for at the contract bid price and shall be considered complete compensation for all labor, equipment, and materials necessary, for piping, discharge/outlet piping, valves, actuators, flowmeter, buried couplings, floor drains, from the well head to the buried couplings outside of the well house, including backfilling, compaction, painting, removal and on-site disposal of excess excavated material, flushing, disinfection and testing; and all other operation and materials required to complete the work as herein described and as shown on the Contract Drawings.

BID ITEM NO. 13 – "PUMP TO WASTE BOX AND PIPING COMPLETE"

METHOD OF MEASUREMENT "Pump to Waste Box and Piping Complete" shall not be measured but shall be paid for on a lump sum basis for furnishing and installing the precast pump to waste box, concrete behind the box and associated reinforced concrete pipe (RCP) and connection to the storm drain collection system and all other items necessary to complete this item.

BASIS OF PAYMENT Payment for "Pump to Waste Box and Piping Complete" shall be made at the contract unit bid price and shall be considered complete compensation for furnishing and installing the precast pump to waste box and associated RCP to connect to the storm drain collection system as shown on the Contract Drawings and as specified herein. Payment shall include, but not be limited to, all labor, equipment, materials necessary for excavation and dewatering the associated trench, furnishing and installing the precast concrete box, RCP, pipe zone material, bedding, backfilling, compaction, removal and on-site disposal of excess excavated material, testing; protection of buried utilities, looping and rerouting any of the existing utilities; restoration of all surface improvements; and all other operations and materials required to complete the work as herein described and as shown on the Contract Drawings.

BID ITEM NO. 14 – "CHLORINATION SYSTEM COMPLETE"

METHOD OF MEASUREMENT "Chlorination System Complete" shall not be measured but shall be paid for on a lump sum basis for furnishing and installing the gas chlorination system, according to the amount defined in the Bid Schedule.

BASIS OF PAYMENT Payment for “Chlorination System Complete” shall be made at the contract lump sum bid price for completion of all pipes, valves, fittings, and equipment necessary to construct a safe and fully functional gas chlorination system as shown on the Contract Drawings and as specified herein. Payment shall include, but not be limited to, all labor, materials, and equipment for furnishing and installing the piping and tubing; necessary valves, fittings, and pressure gauges; chlorine gas ejector box; scales and safety rack; rotameter, four full chlorine bottles (150 lbs) and other dosing equipment; injection quill and saddle; system testing and training, and all other appurtenances and other related items not paid elsewhere for a complete and operable gas chlorination system.

BID ITEM NO. 15 – “ELECTRICAL SYSTEM COMPLETE”

METHOD OF MEASUREMENT “Electrical System Complete” shall not be measured but shall be made at the contract lump sum bid for furnishing and installing all electrical equipment not paid for elsewhere according to the amount defined in the Bid Schedule and as completed by CONTRACTOR.

BASIS OF PAYMENT Payment for “Electrical System Complete” shall be made at the contract lump sum bid price for completion of all electrical work as shown on the Contract Drawings and specified herein. Payment shall include, but not be limited to, all labor, materials, and equipment for furnishing and installing all electrical equipment at the well pump house, panelboards, transformers, lighting, service outlets, pressure switches, pressure transducers, intrusion switches, flood switch, buried conduits, electrical service connection, wiring for equipment controls and signals, grounding, antenna, pump motor terminators, lighting protection system, connections to water quality monitoring equipment, chlorine dosing equipment, HVAC, installing conductors into PLC panel; and all other items as shown on the Contract Drawings required for a complete and operable electrical system.

BID ITEM NO. 16 – “HVAC SYSTEM COMPLETE”

METHOD OF MEASUREMENT “Furnish and Install HVAC Systems Complete” shall not be measured but shall be paid for on a lump sum basis for furnishing and installing the HVAC system according to the amount defined in the drawings and specifications.

BASIS OF PAYMENT Payment for “Furnish and Install HVAC Systems Complete” shall be made at the contract lump sum bid price for HVAC work as shown on the Contract Drawings and specified herein. Payment shall include, but not be limited to all labor, materials, and equipment for furnishing and installing all HVAC equipment, including but not limited to, wire and conduit, instrumentation, air conditioning system, electric unit heaters, ductwork, exhaust fans, supports; filters, louvers; actuated louvers and all other related items as shown on the Contract Drawings not paid elsewhere.

BID ITEM NO. 17 – "16-INCH DISCHARGE PIPELINE, VALVES, AND FITTINGS COMPLETE"

METHOD OF MEASUREMENT "16-Inch Discharge Pipeline, Valves, and Fittings Complete" shall be measured by the Lineal Foot starting after the buried 90-degree bend to the connection point roughly 30 feet north. This shall include furnishing and installing all discharge pipelines, valves and connections as shown on the Contract Drawings. Payment shall be made according to the amount defined in the Bid Schedule and as completed by CONTRACTOR.

BASIS OF PAYMENT Payment for "Discharge Piping" shall be made at the contract unit bid price and shall be considered complete compensation for furnishing and installing all discharge piping and connections as shown on the Contract Drawings and as specified herein. Payment shall include, but not be limited to, all labor, equipment, materials necessary for furnishing and installing all discharge pipes, connections and valves; excavation and dewatering; installing piping and fittings; imported sand pipe zone material, bedding, backfilling with select or native material, compaction, removal and on-site disposal of excess excavated material, flushing, disinfection and testing; protection of buried utilities, looping and rerouting any of the existing utilities; restoration of all surface improvements; and all other operations and materials required to complete the work as herein described and as shown on the Contract Drawings.

BID ITEM NO. 18 – "SIDEWALK AND BOLLARDS"

METHOD OF MEASUREMENT "Sidewalk and Bollards" will be measured by square foot of area covered by the sidewalk thickened slab detail as shown in the Contract Drawings.

BASIS OF PAYMENT Work completed under this bid item shall be paid for at the contract unit bid price per square foot for all work required to install the sidewalk and bollards around the well house. Payment shall include, but not be limited to, all labor, equipment, materials necessary for excavation, compaction of sidewalk base material, forming pits for bollard bases, removal and on-site disposal of excess excavated material, furnishing and installing all rebar, concrete forms, concrete, bollards at interval shown on Contract Drawings, and all other operations and materials required to complete the work as herein described and as shown on the Contract Drawings.

BID ITEM NO. 19 – "TESTING AND COMMISSIONING"

METHOD OF MEASUREMENT "Testing and Commissioning" shall not be measured but shall be paid for on a lump sum basis according to the amount defined in the Bid Schedule.

BASIS OF PAYMENT Payment for “Testing and Commissioning” shall be made at the contract lump sum price for all work required for testing the completed well house and the components therein. Payment shall include, but not be limited to, all labor, equipment, and materials required for all work performed. Testing shall include, but not be limited to, verifying all components are working in accordance with the Contract Drawings and Specifications, verifying all subsystems are in working condition, verifying that the pump motor is wired in the correct direction, and verifying all circuits and panels are wired correctly.

PRODUCTS (Not Used)

EXECUTION (Not Used)

- END OF SECTION -

LIST OF SUBCONTRACTORS

The Bidder shall list below the names and location of place of business of each subcontractor who will perform work or labor or who will render service to the prime contractor in or about the construction of the Work or improvement, or a subcontractor duly licensed who, under subcontract to the prime Contractor, specially fabricates and installs a portion of the Work or improvement according to detailed drawings contained in the Contract Documents, in an amount in excess of one-half of one percent of the prime Contractor’s total bid, or \$10,000, whichever is greater. After the opening of bids, no changes or substitutions will be allowed except as otherwise provided by law. The listing of more than one subcontractor for each item of Work to be performed with the words “and/or” will not be permitted. Does the subcontractor have insurance? Write “yes” or “no” under the column for “Subcontractor Insurance.”

Work to be Performed	Contractor License Number	Percent of Total Contract	Subcontractor’s Name, Address, and Contact Person	Sub-contractor Insurance
1.				
2.				
3.				
4.				

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, _____, as Principal, and _____ as Surety, are hereby held and firmly bound unto the CITY OF OREM as OWNER in the penal sum _____ for payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, successors and assign.

Signed, this _____ day of _____, 201____. The Condition of the above obligation is such that whereas the Principal has submitted to the CITY OF OREM a certain BID, attached hereto and hereby made a part hereof to enter into a contract in writing, for the construction of Heritage Park Utility Pipeline Project.

NOW, THEREFORE,

(a) If said BID shall be rejected, or

(b) If said BID shall be accepted and the Principal shall execute and deliver a contract in the Form of Contract attached hereto (properly completed in accordance with said BID) and shall furnish a BOND for his faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said BID, then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligation of said Surety and its BOND shall be in no way impaired or affected by any extension of the time within the OWNER may accept such BID; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their officers, the day and year first set forth above.

_____(L.S.)
Principal

Surety

By:_____

IMPORTANT - Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the project is located.

INFORMATION REQUIRED OF BIDDER

The Bidder shall furnish the following information. Additional sheets shall be attached as required. **Failure to complete Item Nos. 1 and 2, will cause the bid to be non-responsive and may cause the bid to be non-responsive and may cause its rejection.** In any event, no award will be made until all the Bidder's General Information (i.e., items 1 through 6, inclusive) is delivered to the OWNER.

1. CONTACT INFORMATION:

Contractor Name: _____

Address: _____

Telephone Number: _____

2. LICENSE: A copy of your current Utah State Contractors License must be attached.

3. INSURANCE: Attach a Certificate of Insurance from your insurance company. Minimum amount of insurance under General Liability are as follows:

General Liability: \$2,000,000.00 combined single limit per occurrence for bodily injury, personal injury and property damage. If the General Liability Insurance has a general aggregate limit, either the general aggregate limit shall be \$4,000,000.00 or the general aggregate limit shall apply separately to this Agreement/Project, pursuant to a policy endorsement. If the general aggregate limit applies separately to this agreement/project, the general aggregate limit shall be \$3,000,000.00.

Automobile Liability: \$2,000,000.00 combined single limit per accident for bodily injury and property damage.

The Certificate of Insurance must include an additional insured endorsement. Blanket additional insured endorsements are usually acceptable. If not using a blanket additional insured endorsement, the additional insured endorsement must list the following as additional insureds: "THE CITY OF OREM, ITS' ELECTED AND APPOINTED OFFICIALS, OFFICERS, EMPLOYEES AND VOLUNTEERS." Certificates without additional insured endorsements will not be accepted.

Workers' Compensation and Employers Liability: Workers' compensation limits s required by Utah State Law and Employer's Liability Limits of \$ 1,000,000.00 per accident or as required by Section 21 of the General Conditions.

Please NOTE the following is part of the contract: The CITY, its officers, officials, employees and volunteers shall be covered as additional insureds as respects: liability arising out of activities performed by or on behalf of CONTRACTOR, including the insured's general supervision of CONTRACTOR; products and completed operations of CONTRACTOR; premises owned, occupied or used by CONTRACTOR; or automobiles owned, leased, hired or borrowed by CONTRACTOR. The coverage shall contain no special limitations on the scope of protection afforded to the OWNER, its officers, officials, employees or volunteers. The applicant shall hold harmless, indemnify and defend the City of Orem from any liability claims, losses or damages arising or alleged to arise from the work covered by any permit but not including the sole negligence of the City of Orem.

AGREEMENT

THIS AGREEMENT, made and entered into this ___ day of _____, 20___, by and between OREM CITY, hereinafter called "Owner", and _____ hereinafter called "Contractor".

WITNESSETH, that the parties hereto do mutually agree as follows:

ARTICLE I: For and in consideration of the payments and agreements hereinafter mentioned to be made and performed by said Owner, said Contractor agrees with said Owner to perform and complete in a workmanlike manner all work required under the bidding schedule(s) _____ of said Owner's Specifications entitled Heritage Park Booster Pump Station and Well House 10 in accordance with the Specifications and drawings therefore, to furnish at his own expense all labor, materials, equipment, tools, and services necessary therefore, except such materials, equipment, and services as may be stipulated in said Specifications to be furnished by said Owner, and to do everything required by this Agreement and said Specifications and drawings.

ARTICLE II: For furnishing all said labor, materials, equipment, tools, and services, furnishing and removing all plant, temporary structures, tools, and equipment, and doing everything required by this Agreement and the said Specifications and drawings; also for all loss and damage arising out of the nature of the work aforesaid, or from the action of the elements, or from any unforeseen difficulties which may arise during the prosecution of the work until its acceptance by said Owner, and for all risks of every description connected with the work, also for all expenses resulting from the suspension or discontinuance of work, except as in the said Specifications are expressly stipulated to be borne by said Owner; and for completing the work in accordance with the requirements of said Specifications and drawings, said Owner will pay and said Contractor shall receive, in full compensation therefor, the price(s) named in the above-mentioned proposal(s).

ARTICLE III: The Owner hereby contracts with said Contractor to perform the work according to the terms of this Agreement for the above-mentioned price(s), and agrees to pay the same at the time, in the manner, and upon the conditions stipulated in the said Specifications; and the said parties for themselves, their heirs, executors, administrators, successors, and assignees, do hereby agree to the full performance of the covenants herein contained.

ARTICLE IV: The Notice Inviting Bids, Information for Bidders, Instructions to Bidders, Proposal, Performance and other bonds, Notice of Award, Notice to Proceed, Information Required of Bidder, Information for Preparing Proposal, General Conditions, Specifications, drawings, and all addenda issued by the Owner with respect to the foregoing prior to the opening of bids, are hereby incorporated in and made part of this agreement.

ARTICLE V: The parties herein each agree that should they default in any of the covenants or agreements contained herein, the defaulting party shall pay all costs and expenses, including a reasonable attorney's fee which may arise or accrue from enforcing this agreement, or in pursuing any remedy provided hereunder or by the statutes or other laws of the State of Utah, whether such costs and expenses are incurred with or without suit or before or after judgment period.

IN WITNESS WHEREOF, the parties hereto have caused this Contract to be executed the day and year first above written.

OWNER

OREM CITY

Attest: _____
Signature

Title

By: _____
Signature

Title

(Seal)

CONTRACTOR

Attest: _____
Signature

Title

By: _____
Signature

Title

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS:

that _____(Name of Contractor)

(Address of Contractor)

a _____, hereinafter called Principal, and

(Name of Surety)

(Address of Surety)

hereinafter called Surety, are held and firmly bound unto The City of Orem 56 North State Street, Orem, UT 84057 hereinafter called OWNER, in the penal sum of _____ Dollars (\$_____) in lawful money of the United States, for the payment of which sum well and truly be made, we bind ourselves successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain contract with the OWNER, dated the _____ day of _____, 2023, a copy of which is hereto attached and made a part hereof for the construction of Heritage Park Booster Pump Station Project.

NOW, THEREFORE, if the Principal shall promptly make payment to all persons, firms, SUBCONTRACTORS, and the corporation furnishing materials for or performing labor in the prosecution of the WORK provided for in such contract, and any authorized extension or modification thereof, including all amounts due for materials, lubricants, oil, gasoline, coal and coke, repairs on machinery, equipment and tools, consumed or used in connection with the construction of such WORK and all insurance premiums on said WORK, and for all labor, performed in such WORK whether by SUBCONTRACTOR or otherwise, then this obligation shall be void; otherwise, to remain in full force and effect.

PROVIDED, FURTHER, that the said Surety for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or to the WORK to be performed thereunder or the specifications accompanying the same shall in any wise affect its obligation on this BOND, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract or to the WORK or to the specifications.

PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed _____ counterparts, each one of which shall be deemed an original, this the _____ day of _____, 2023.

Principal

ATTEST:

Principal Secretary

By _____

Address

Witness as to Principal

Address

Surety

ATTEST: By _____ Attorney-in-Fact

Witness as to Surety Address

NOTE: Date of BOND must not be prior to date of Contract.
If CONTRACTOR is partnership, all partners should execute BOND.

IMPORTANT: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State where the PROJECT is located.

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: that

(Name of Contractor)

(Address of Contractor)

a _____, hereafter called Principal, and
(Corporation, Partnership or Individual)

(Name of Surety)

(Address of Surety)

hereinafter called Surety, are held and firmly bound unto The City of Orem, 56 North State Street, Orem, Utah, 84057 hereinafter called OWNER, in the penal sum of _____ Dollars, (\$) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THE OBLIGATION is such that whereas, the Principal entered into a certain contract with the OWNER, dated the _____ day of _____, 2023, a copy of which is hereto attached and made a part hereof for the construction of Heritage Park Booster Pump Station Project.

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms, conditions, and agreement of said contract during the original term thereof, and any extensions thereof may be granted by the OWNER, with or without notice to the Surety and during the one year guaranty period, and if he shall satisfy all claims and demands incurred under such contract, and shall fully indemnify and save harmless the OWNER from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the OWNER all outlay and expense which the OWNER may incur in making good any default, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said surety, for value received hereby stipulates and agrees that no charge, extension of time, alteration or addition to the terms of the contract or to WORK to be performed thereunder or the SPECIFICATIONS accompanying the same shall in any wise affect its obligation on this BOND, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract or to the WORK or to the SPECIFICATIONS.

PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in _____(Number) counterparts, each one of which shall be deemed an original, this _____ day of _____, 2023.

ATTEST:

_____ Principal

(Principal Secretary)

By _____

(SEAL)

Witness as to Principal

Address

Address

Surety

ATTEST:

Surety Secretary

(SEAL)

Witness as to Surety

By _____
Attorney-in Fact

Address

Address

NOTE: Date of BOND must not be prior to the date of Contract. If CONTRACTOR is Partnership, all partners should execute BOND.

IMPORTANT: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the PROJECT is located.

NOTICE OF AWARD

OREM CITY

Heritage Park Booster Pump Station and Well House 10

TO: _____

PROJECT DESCRIPTION: Heritage Park Booster Pump Station and Well House 10

OREM CITY has considered the BID submitted to you for the above described WORK in response to its Notice Inviting Bids and Instructions to Bidders.

You are hereby notified that your BID has been accepted for items in the amount of \$ _____ for bid schedule(s) _____.

You are required by the Instructions to Bidders to execute the Contract and furnish the required Contractor's Performance Bond and Payment Bond and certificates of insurance within ten calendar days from the date of this Notice to you.

If you fail to execute said Contract and to furnish said bonds within ten days from the date of this Notice, said Owner will be entitled to consider all your rights arising out of the Owner's acceptance of your BID as abandoned and as a forfeiture of your Bid Bond. The Owner will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of NOTICE OF AWARD to the Owner.

Dated this ____ day of _____, 20____.

By _____

Title _____

ACCEPTANCE OF NOTICE OF AWARD

By _____

Title _____

Date _____

NOTICE TO PROCEED

OREM CITY

Heritage Park Booster Pump Station and Well House 10

TO: _____ DATE: _____

PROJECT DESCRIPTION: HERITAGE PARK BOOSTER PUMP STATION REPLACEMENT

You are hereby notified to commence work in accordance with the Contract dated _____, 20 ____, on or before _____, 20 ____, and you are to complete the work as specified in the Information for Bidder - Time of Completion.

By _____

Title _____

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE to PROCEED is hereby acknowledged by

this the _____ day of

_____, 20 ____.

By _____

Title _____

CONTRACTOR'S APPLICATION FOR PAYMENT

To: _____

From: _____

Project: Heritage Park Booster Pump Station and Well House 10

Payment Request No.: _____

Period: _____ through _____

- | | | |
|-------------------------------------|---------------------|------------------------|
| 1. Contract Time | _____ Calendar Days | Purchase Order # _____ |
| 2. Time Elapsed | _____ Calendar Days | Request # _____ |
| 3. Remainder | _____ Calendar Days | |
| 4. Work Completed | _____ Percent | |
| 5. Time Elapsed | _____ Percent | |
| 6. Original Contract Amount | | \$ _____ |
| 7. Approved Change Order No's _____ | | \$ _____ |
| 8. Adjusted Contract Amount | | \$ _____ |

	<u>Previous Period</u>	<u>This Period</u>
9. Total Value to Date	9a _____	9b _____
10. Total Retainage to Date	10a _____	10b _____
11. Value This Request	11a _____	11b _____
12. Retainage This Request	12a _____	12b _____
13. Reduction of Retainage	13a _____	13b _____

14. NET PAYMENT AMOUNT TO CONTRACTOR _____

We certify the above is a true statement of work done.

CONTRACTOR -

BY: _____

TITLE: _____

DATE: _____

ENGINEER - EPIC ENGINEERING, P.C.

OWNER - OREM CITY

BY: _____

BY: _____

TITLE: _____

TITLE: _____

DATE: _____

DATE: _____

(Instructions on Next Page)

PAYMENT REQUEST INSTRUCTIONS

ITEM

2. Elapsed Calendar Days from Date of Notice to Proceed.
3. Item 1 Minus Item 2
4. Divide Item 9b by Item 8 and Multiply by 100
5. Divide Item 2 by Item 1 and Multiply by 100
- 9a. Item 9b from Previous Payment Request
- 10a. Item 10b from Previous Payment Request
- 11a. Item 11b from Previous Payment Request
- 12a. Item 12b from Previous Payment Request
- 13a. Item 13b from Previous Payment Request
- 9b. Total Value of Work Completed to Date of this Request (Attach Payment Breakdown).
- 10b. 5% of Item 9b Unless Some Other (Smaller) Percent Reduction is Allowed by Owner.
- 11b. Item 9b Minus Item 9a.
- 12b. Item 10b Minus Item 10a.
- 13b. Amount Authorized by Owner.
14. Item 11b Minus Item 12b Plus Item 13b.

CHANGE ORDER

ORDER NO. _____
DATE _____
ORIGINAL PO # _____

CONTRACT FOR: Heritage Park Booster Pump Station and Well House 10

OWNER: OREM CITY

TO: _____
(Contractor)

You are hereby requested to comply with the following changes from the Contract Documents, Plans and Specifications:

Description of Changes (Supplemental Plans & Specifications Attached)	Item	Decrease Contract Price	Increase Contract Price
---	------	----------------------------	----------------------------

JUSTIFICATION: _____

Contract Price will be _____ by the sum of: \$ _____

Current Contract Price including previous Change Orders \$ _____

New Contract Price including this Change Orders will be: \$ _____

This document will become a modification to the Contract and all provision will apply hereto.

Requested _____
(Contractor) (Date)

Recommended _____
(Engineer) (Date)

Approved _____
(Owner) (Date)

AFFIDAVIT OF PAYMENT

OREM CITY

To All Whom it May Concern:

WHEREAS, the undersigned Contractor has furnished labor and materials under a contract dated for the project named Heritage Park Booster Pump Station and Well House 10 of which OREM CITY is the Owner.

NOW, THEREFORE, this _____ day of _____, 20 ____, the undersigned Contractor hereby certifies that, except as listed below, he has paid in full or has otherwise satisfied all obligations for all materials and equipment furnished, for all work, labor, and services performed, and for all known indebtedness and claims against the Contractor for damages arising in any manner in connection with the performance of the Contract referenced above for which the Owner or his property might in any way be held responsible.

EXCEPTIONS: (If none, write "none". If required by the Owner, the Contractor shall furnish bond satisfactory to the Owner for each Exception.)

Contractor (Name of sole ownership, corporation or partnership)

Affix corporate
seal here

(Signature of Authorized Representative)

Title: _____

CONSENT OF SURETY FOR FINAL PAYMENT

OREM CITY

Project Name Heritage Park Booster Pump Station and Well House 10

Location _____

Type of Contract _____

Amount of Contract _____

In accordance with the provisions of the above-named contract between the Owner and the Contractor, the following named surety:

on the Payment Bond of the following named Contractor:

hereby approves of final payment to the Contractor, and further agrees that said final payment to the Contractor shall not relieve the Surety Company named herein of any of its obligations to the following named Owner (as set forth in said Surety Company's bond):

IN WITNESS WHEREOF, the Surety Company has hereunto set its hand and seal this _____ day of _____, 20 __.

(Name of Surety Company)

(Signature of Authorized Representative)

(Name of Authorized Representative)

Title: _____

NOTICE INVITING BIDS

Electronic bids for construction of the **Heritage Park Booster Pump Station & Well House #10** will be received on Bidnet Direct until 2:00 p.m. on December 31st, 2024, after which time the proposals will be publicly opened and read aloud. Any bid received after the scheduled closing time for receipt of bids will be returned unopened. Bids will only be accepted by those pre-qualified contractors having received a letter from the City authorizing the contractor to bid the project.

Construction work, in general, consists of the following:

Booster Pump Station: Construction of a 12,000 GPM culinary water booster pump station including an insulated concrete form (ICF) building, vertical turbine pump and motors w/pump cans, pump suction and discharge piping, bridge crane system, heating and ventilation, electrical, standby generator, public restroom facilities.

Well House: Construction of a 5,000 GPM ground well pump station including a concrete masonry unit (CMU) building, vertical turbine pump and motors w/pump can, pump suction and discharge piping, heating and ventilation, electrical, and chlorine injection system & storage.

Site Improvements: Construction of feet of 30-inch welded steel pipe, 36-inch welded steel pipe, 30" welded steel headers, RCP Class III stormwater pipe and catch basins, electrical conduit, potable water and sewer service laterals, curb & gutter, sidewalk, asphalt parking lot and landscaping, asphalt road restoration on 400 S and 400 W for right-hand turn lane.

The anticipated substantial completion date for this project will be **November 25th, 2025**.

Electronic copies of the Contract Documents, Specifications and Plans may be requested by emailing Braden Vance at bvance@epiceng.net. Those interested in printed copies of Contract Documents, Specifications and Plans may obtain them from EPIC ENGINEERING upon request at a fee of \$60 per 11" x 17" plan set. A minimum of 24 hours' notice is required to pick up printed copies of the project documents. Acceptable payment options for the above items include cash, cashier's check, or company check. Refunds for Contract Documents, Specifications and Plans will not be made.

Bid security in the form of a certified check, cashier's check or bid bond in the amount of five percent (5%) of the bid shall accompany each proposal.

Orem City reserves the right to reject any or all bids, waive any informality in a bid or to withhold the Award for any reason Orem City determines.

A pre-bid conference will be held at the office of Orem City Public Works, located at 1450 550 North, Orem, UT 84057 on Monday, December 16, 2024 at 1 PM. A site visit to the future Booster Pump Station and Well House 10 location will follow the pre-bid conference.

OREM CITY

Lane Gray
Capital Projects Manager

INFORMATION FOR BIDDERS

SECURING DOCUMENTS

Contract Documents, Specifications and Plans may be procured by emailing Braden Vance at bvance@epiceng.net - Printed copies are available on request for \$60 per 11" x 17" plan set.

SUBMISSION OF BIDS

BIDS will be received by the City of Orem, herein called the "OWNER", electronically submitted using Bidnet Direct or at Development Services until 2:00 pm on Wednesday, November 20th, 2024, and will be downloaded from Bidnet Direct and read aloud. An invitation to bid will be sent to every prequalified contractor.

All BIDS must be made on the required BID form. All blank space for BID prices must be completed in ink or typewritten, and the BID form must be fully completed and executed when submitted. Only one copy of the BID form is required.

The OWNER may waive any informalities or minor defects or reject any and all BIDS. Any BID received after the time and date specified shall not be considered. No BIDDER may withdraw a BID within 60 days after the actual date of the bid opening.

PROPOSAL

Bids to receive consideration shall be made in accordance with the following instructions:

Before submitting a bid, bidders shall carefully read the Plans and Specifications, visit the site of the work, fully inform themselves as to all existing conditions and limitations, and shall include sums in the bid covering the cost of each item included in the Contract. Submission of a Proposal shall be considered prima facie evidence that the bidder has made such examination and is satisfied as to the conditions to be encountered in performing the work and as to the requirements of the Plans, Specifications, and other Contract Documents.

Bids shall be properly executed upon the Proposal attached to and made part of these Contract Documents. Numbers shall be stated both in writing and in figures where so required, and the signatures of all persons signing shall be in longhand. The completed forms shall be without interlineations, alterations, or erasures. In case of a difference in written words and figures in a Proposal, the amount stated in written words shall govern unless obviously in error.

Bids shall not contain any recapitulations of the work to be done. Alternative proposals will not be considered unless called for. No oral, telegraphic, telephonic, or modified proposals will be considered.

All bids shall be made in accordance with applicable statutes of the State of Utah, applicable local laws, and as specified in this Book of Specifications.

BID SECURITY

Each Proposal shall be accompanied by a certified check, cashier's check, or bid bond acceptable to the

GENERAL CONDITIONS - PART 1

DEFINITIONS

Wherever in these Specifications, or in other Contract Documents, the following terms are used, the intent and meaning shall be interpreted as shown below. Additional definitions and abbreviations pertaining to this project will be found in Special Conditions, Section 010090.

1-1 DEFINITIONS

ADDENDUM: A supplement to any of the Contract Documents issued, in writing, after advertisement of but prior to the opening of bids for a Contract.

ADVERTISEMENT: The public announcement, as required by law, inviting bids for work to be performed or materials to be furnished.

AWARD: The formal action of the governing body in accepting a proposal.

BID SECURITY: Refers to the certified check, cashier's check, or surety bond, which is required to be submitted with the Proposal to insure execution of the Contract and the furnishing of the required bonds.

BIDDER: Any individual, firm, co-partnership, or corporation submitting a Proposal for the work contemplated, acting directly or through a duly authorized agent.

CHANGE ORDER: A written order issued by the Owner ordering the Contractor to make changes in the work or to perform extra work, and setting forth conditions for payment and adjustment in time of completion.

CITY: A municipal corporation, organized and existing under and by virtue of the laws of the State.

CLERK: The word "Clerk" refers to the duly authorized person who performs the duties of Clerk of the Contracting Agency.

CONTRACT: The written instrument executed by the Contractor and the Owner by which the Contractor is bound to furnish all labor, equipment, and materials and to perform the work specified, and by which the Owner is obligated to compensate the Contractor therefore at the prices set forth therein. The Contract Documents are herewith by reference made a part of the Contract as if fully set forth therein.

CONTRACT DOCUMENTS: The words "Contract Documents" include the Notice Inviting Bids, Information for Bidders, General Conditions, Special Conditions, Specifications, Measurement and Payment or Instructions for Preparing Proposal, Proposal, Contract, Payment Bond, Performance Bond, Plans, and Addenda thereto.

CONTRACTING AGENCY: The legal entity that has contracted for the performance of the work or for whom the work is being performed.

CONTRACTOR: The person or persons, copartnership, or corporation who has or have entered into a contract with the Owner as a party or parties of the first part or his or their legal representatives.

DAYS: Unless otherwise designated, days will be understood to mean calendar days.

DESIGN ENGINEER: The firm or person and his properly authorized assistants, designated by the Owner to prepare Plans and Specifications for the work.

ENGINEER: The firm or person and his properly authorized assistants, designated by the Owner to inspect construction of the work for compliance with the Plans and Specifications.

MATERIALS: The word "materials" includes, in addition to material incorporated in the project, equipment and other material consumed in the performance of the work.

NOTICE TO CONTRACTORS: Refers to the standard forms inviting Proposals or bids.

NOTICE TO PROCEED: A directive issued by the Owner, authorizing the Contractor to start the work or improvements required in the Contract.

OWNER: The word "Owner" refers to the individual, company, municipality or other legal entity that has contracted for the work or for whom the work is being performed.

OWNER'S REPRESENTATIVE OR OWNER'S AGENT: The authorized representative of the Owner, which may be an individual or a firm, the Engineer, or his assistants assigned to the project work, the project site, or any part thereof during the performance of the work by the Contractor and until final acceptance.

PAYMENT BOND: A bond furnished by the Contractor and an acceptable surety, conditioned upon the Contractor promptly paying all monies due persons supplying labor or material to be used in prosecution of the Contract.

PERFORMANCE BOND: A bond furnished by the Contractor and an acceptable surety, conditioned on the faithful performance and completion of the work covered by the Contract.

PLANS: All drawings or reproductions thereof pertaining to details of the work and which are made a part of the Contract Documents.

SPECIAL CONDITIONS: The special conditions and requirements, applicable to the work, that are not covered in detail under other sections of these Contract Documents.

SPECIFICATIONS: The directions, provisions, and requirements for performing the work, as contained in the Contract Documents.

SUBCONTRACTOR: The word "subcontractor" includes those having a direct contract with the Contractor and those who furnish material worked into a special design according to the Plans and Specifications for this work, but does not include those who merely furnish material not so worked.

SURETY: Refers to the person or firm with whom the Contractor joins in assuming the liability for the performance of the Contract by issuing the bonds required by law.

TOWNSHIP, CITY, TOWN, OR DISTRICT: A subdivision of the County used to designate or identify the location of the proposed work.

WORK: The word "work" or "improvement" includes any or all of the improvements mentioned and authorized to be made, and the construction, reconstruction, and repair of all, or any portion of such improvements, and all labor, services, incidental expenses, and material necessary or incidental thereto.

* * * END OF GENERAL CONDITIONS - PART 1 * * *

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GENERAL CONDITIONS - PART 2

BIDDING REQUIREMENTS AND CONDITIONS

2-1 SUBMITTING BIDS

No bid will be considered unless it is made upon the Proposal forms contained in and submitted with the book of Contract Documents. No book of Contract Documents shall be disassembled.

No bid shall be considered which is deemed as an irregular Proposal. Proposals may be considered irregular and may be rejected by the Owner if they show any alterations of form, unauthorized additions, unauthorized conditional or alternate bids, incomplete bids, obviously unbalanced prices, erasures, or irregularities of any kind.

No bid will be considered unless accompanied by the Bid Security in the type and amount set forth in Information for Bidders.

Bids shall be submitted in a sealed envelope. The outside, upper left-hand corner of the ENVELOPE shall be marked as follows:

Bid of _____, Contractor

Project Name _____

Proposals will be received until the hour and date set for the opening thereof, and must be, by that time, in the hands of officials so designated in Notice Inviting Bids. Proposals received after the time set for opening of bids will be returned to the bidders unopened.

The bids will be publicly opened and read at the time and place designated in the Notice Inviting Bids.

The Owner reserves the right to reject any or all bids when deemed advisable for the public good.

2-2 EXAMINATION OF PLANS AND SITE OF WORK

The bidder is required to examine carefully the site of the proposed work, the Plans, Specifications, Special Conditions, Proposal, Contract Agreement, and Bond forms before submitting a Proposal. Submission of a Proposal shall be considered prima facie evidence that the bidder has made such examination and is satisfied as to the conditions to be encountered in performing the work and as to the requirements of the Plans, Specifications, and other Contract papers.

2-3 DISQUALIFICATION OF BIDDERS

More than one Proposal for the same work from an individual, a firm or partnership, a corporation, or an association under the same or different names, will not be accepted. Reasonable ground for believing that any bidder is interested in more than one Proposal for the same work, will cause the rejection of all Proposals for the work in which such a bidder is interested. Any or all Proposals will be rejected if there is reason for believing that collusion exists among any of the bidders.

2-4 ADDENDA

Any Addenda issued during the time of bidding, forming a part of the Documents issued to the bidder for the preparation of his bid, shall be covered in the bid and shall be made a part of the Contract.

* * * END OF GENERAL CONDITIONS - PART 2 * * *

GENERAL CONDITIONS - PART 3

AWARD AND EXECUTION OF CONTRACT

3-1 AWARD

The Owner, through its duly authorized body or agent, will award the Contract to the lowest responsible bidder, or all bids will be rejected, as soon as practicable after the date of opening of bids.

A Notice of Award will be sent to the successful bidder by certified mail.

The low bid will be determined by the lowest net total arrived at by combining the bidder's lump sum and unit price totals or lump sum base bid price and the bid prices of the alternates that are selected and accepted by the Owner. The Owner may accept or reject any or all alternates.

3-2 EXECUTION OF CONTRACT

The successful bidder shall, within the time specified in Information for Bidders, execute the Contract and simultaneously therewith furnish the required Payment Bond and Performance Bond, in the amounts indicated in the Information for Bidders, and shall file insurance policies and/or certificates of insurance as required herein.

3-3 CONTRACTOR'S INSURANCE

GENERAL: On all projects, the Contractor shall carry all insurance required by Federal, State, County, and local laws. The Contractor shall procure and maintain, during the life of the Contract, adequate fire, workmen's compensation, public liability, and property damage insurance. The specific requirements for insurance as set forth in these General Conditions, shall be considered as minimum requirements.

The Contractor shall furnish satisfactory proof of carriage of insurance, or satisfactory proof of an approved self-insured program, and shall submit to the Owner, before work on the Contract starts, certificates of all insurance policies, bonds, or self-insured programs. Neither the Contractor, nor any subcontractor, shall commence work under this Contract until the Owner has approved all required insurance policies. The certificates of insurance shall be attached to the Contract by the Owner and filed in the Owner's office.

Certificates of said policies shall provide that if the said policy or policies be canceled by the insurance company during the term of the Contract, that thirty (30) days written notice prior to cancellation will be given the Owner. Insurance certificates will be retained by the Owner. Insurance certificates shall set

forth the following information and shall be signed by an authorized representative of the insurance company:

Name and address of the insured.

The location of the operations to which the insurance applies.

The number of the policy and the type or types of insurance in force thereunder on the date borne by the certificate.

The expiration date of the policy and the limit or limits of liability thereunder on the date borne by the certificate.

A statement that the insurance covered by the certificate applies to all of the operations on and at the site of the project which are undertaken by the insured during the life of the Contract.

Public liability and Comprehensive General Liability, completed operations broad form property damage insurance shall include elevator liability, water damage liability, and automobile liability including nonowned and rented cars.

A statement that all coverage is on an occurrence basis rather than an accident basis.

A statement that "explosion, collapse, and underground" coverage is included.

A provision that the policy or policies may not be canceled or reduced in coverage until at least thirty (30) days after written notice has been sent to the Owner.

A statement that a cross liability or severability of interests clause is included (unless a separate policy covering the Owner is provided).

In lieu of an insurance certificate setting forth all the required information concerning the coverages, a copy of the complete policy or policies may be furnished to the Owner.

COMPENSATION INSURANCE: The Contractor shall take out and maintain Workmen's Compensation Insurance for all his employees employed at the site of the project during the life of his Contract. In case any work is sublet, the Contractor shall require each subcontractor to provide Workmen's Compensation Insurance for his employees unless such employees are covered by the Contractor. The above coverage is required unless such employees are covered by the protection afforded by the Contractor under a self-insurance plan or with a private carrier approved by the State Industrial Commission.

In the event any class of employees engaged in hazardous work under this Contract is not protected by the Workmen's Compensation Statute, the Contractor shall provide, and shall cause the subcontractor to provide special insurance for the protection of such employees not otherwise protected.

COMPREHENSIVE GENERAL LIABILITY AND PROPERTY DAMAGE INSURANCE: The Contractor shall procure, and maintain during the life of his Contract, such comprehensive general liability and property damage insurance necessary to protect him, the Owner and Epic Engineering, or any subcontractor performing work under his Contract, from all claims for bodily injury, including accidental death and property damage claims arising from operations under this Contract, whether such operations are the Contractor's or the subcontractors'. **The Owner and Epic Engineering shall be named as additional primary insureds without offset against their existing insurance, and the certificate of insurance shall include reference to such provisions.**

Unless otherwise specifically required by the Special Conditions, the minimum limits of comprehensive general liability and property damage liability shall be as follows:

Comprehensive general liability insurance for injuries, including accidental death, to any one person in an amount not less than	\$1,000,000
Subject to the same limits on account of one occurrence, in a total amount not less than	\$1,000,000
Broad form property damage insurance in an amount not less than	\$1,000,000

Such policy shall not exclude coverage for the following:

Injury to or destruction of any property arising out of the collapse of/or structural injury to any building or structure due:

To grading of land excavation, borrowing, filling, backfilling, tunneling, pile driving, cofferdam work, or caisson work; or

To moving, shoring, underpinning, raising, or demolition of any building or structure, or removal or rebuilding of any structural support thereof.

Injury to or destruction of wires, conduits, pipes, mains, sewers, or other similar property or any apparatus in connection therewith, below the surface of the ground, if such injury or destruction is caused by and occurs during the use of mechanical equipment for the purpose of grading of land,

paving, excavating, drilling; or injury to or destruction of any property at any time resulting therefrom.

Injury to or destruction of any property arising out of blasting or explosion.

Motor vehicle public liability and property damage insurance to cover each automobile, truck, and other vehicle used in the performance of the Contract in an amount of not less than One Million Dollars (\$1,000,000) for one person, and One Million Dollars (\$1,000,000) for more than one person, and property damage in the sum of One Million Dollars (\$1,000,000) resulting from any one occurrence which may arise from the operations of the Contractor in performing the work provided for herein.

The Contractor shall secure "All Risk" type Builder's Risk Insurance for Work to be performed. Unless specifically authorized by the Owner, the amount of such insurance shall not be less than fifty percent (50%) of the Contract Price. Such policy shall include coverage for earthquake, landslide, flood, collapse, or loss due to results of faulty workmanship, during the Contract Time and until final acceptance of Work by the Owner.

If the Owner is added as an additional insured, the policy or policies shall contain a cross liability or severability of interest clause. As an alternative, the Contractor may secure, in the name of the Owner, and pay for an Owner's Protective Policy for the minimum limits required. In this event, the original policy shall be filed with the Owner in lieu of a certificate of insurance.

3-4 NOTICE TO PROCEED

The Contractor or subcontractor shall not start work on any part of the project until a Notice to Proceed has been issued by the Owner. The Notice to Proceed will be sent to the Contractor by Certified mail or delivered to him in person.

3-5 ASSIGNMENT OF PAYMENTS

Claims for monies due or to become due the Contractor may be assigned to a bank, trust company, or other financing institution, and may thereafter be further assigned and re-assigned to any such institution. Any such assignment or re-assignment may be made to one (1) party as agent or trustee for two (2) or more parties participating in such financing. No assignment by the Contractor of any Contract to be entered into hereunder, or of any part thereof, or of funds to be received thereunder by the Contractor will be recognized by the Owner unless such assignment has had prior consent of the Owner and the Surety has been given due notice of such assignment in writing and has consented thereto in writing.

* * * END OF GENERAL CONDITIONS - PART 3 * * *

GENERAL CONDITIONS - PART 4

COMMENCEMENT, PROSECUTION, AND PROGRESS

4-1 COMMENCEMENT

The Contractor or subcontractor shall commence work on or before the tenth (10th) day after receiving the Notice to Proceed, and shall complete all work under the Contract within the period of time specified in the Special Conditions. Notice to Proceed will be issued not later than thirty (30) days after the Contract has been awarded unless otherwise agreed upon in writing, or as may be specified in the Special Conditions.

4-2 SUBCONTRACTORS

Subcontracts shall be in accordance with, and the Contractor shall be bound by, the following provisions:

All subcontracts shall be subject to review and acceptance by the Owner.

All subcontracts shall be in writing and shall provide that all work to be performed thereunder shall be performed in accordance with the terms of the Contract.

True copies of any and all subcontracts shall be furnished to the Owner; however, prices may be omitted.

Subcontractors shall conform to the regulations governing employment of labor.

The subcontracting of any part of the work will in no way relieve the Contractor of his responsibility or liability or obligation under the Contract.

All subcontracts and purchase orders for equipment shall state and establish guaranteed delivery dates, at such times as determined by the Contractor, that will allow the Contractor to complete the project within the Contract time.

4-3 CONTRACTOR'S REPRESENTATIVE AND EMERGENCIES

The Contractor shall at all times be present at the work in person or represented by a competent superintendent who shall supervise and direct the work and shall be authorized by the Contractor to receive and fulfill instruction from the Owner's Representative.

The Contractor shall, at all times during working hours, be represented in all matters pertaining to this project by one, and only one, fully competent and experienced general superintendent. Instructions and information given by the Engineer to the Contractor's superintendent on the work shall be considered as

having been given to the Contractor. Before any work is done at the jobsite, the Contractor shall give written notice to the Engineer stating who the Contractor's superintendent will be, giving his home address and telephone number. The Engineer shall be informed in writing prior to any change of general superintendent. A statement naming more than one representative at a time to be in charge and depending upon which is present at the time will not be acceptable.

Emergencies may arise during the progress of the work which may require special effort or require extra shifts of men to continue the work beyond normal working hours. The Contractor shall be prepared in case of such emergencies from whatever cause, to do all necessary work promptly.

4-4 CONTRACT DOCUMENTS

The Contractor shall keep on the work a copy of the Contract Documents and shall at all times give the Engineer access thereto.

The Notice Inviting Bids, Information for Bidders, Special Conditions, Specifications, Plans, and all supplementary documents are intended to be complete, and complementary and to prescribe a complete work. If any omissions are made of information necessary to carry out the full intent and meaning of the Contract Documents, the Contractor shall immediately call the matter to the attention of the Engineer for furnishing of detail instructions. In case of discrepancies, the Specifications shall govern over the Plans. Figured dimensions shall govern over scaled dimensions.

Any drawings or Plans listed anywhere in the Specifications or Addenda thereto shall be regarded as a part thereof and of the Contract. Anything mentioned in these Specifications and not indicated on the Plans, or anything indicated on the Plans and not mentioned in these Specifications, shall be in the same force and effect as if indicated or mentioned in both.

4-5 ADDENDA, REVISIONS AND SUPPLEMENTARY DRAWINGS

The work shall conform to such other drawings relating thereto as may be furnished by the Owner prior to the opening of Proposals, and to such drawings in explanation of details or minor modifications as may be furnished from time to time during construction including such minor modifications as the Owner may consider necessary during the prosecution of the work.

Scaled dimensions shall not be used in the construction of the work.

4-6 ERRORS AND OMISSIONS

The written dimensions on the Plans are presumed to be correct, but the Contractor shall be required to check carefully all dimensions before beginning the work. If any errors or omissions are discovered, the Engineer shall be so advised in writing and will make the proper corrections. Any such adjustments made by the Contractor without prior review and acceptance shall be at his own risk, and the settlement of any

complications or disputed expenses arising from such adjustment shall be made by the Contractor, at his own expense.

4-7 QUALIFICATIONS FOR EMPLOYMENT

No person under the age of sixteen (16) years for normal occupations, no person under the age of eighteen (18) years in hazardous occupations, and no person currently serving a sentence in a penal or correctional institution shall be employed to perform any work under this Contract.

No person whose age or physical condition is such as to make his employment dangerous to his health or safety, or to the health and safety of others, shall be employed to perform any work under this Contract provided, however, this condition shall not operate against the employment of physically handicapped persons who, otherwise employable, may safely be assigned to work which they can ably perform.

4-8 CHARACTER OF WORKMEN

Whenever, in the opinion of the Engineer, any superintendent, foreman, or workman employed by the Contractor or his subcontractors is disrespectful, intemperate, disorderly, or otherwise objectionable, he shall, at the written request of the Engineer, be removed and not again employed on the work without the written consent of the Engineer.

4-9 SUSPENSION OF WORK

The Contractor shall suspend the work wholly or in part for such period as he may deem necessary due to unsuitable weather or to such other conditions as are considered unfavorable for the suitable prosecution of the work.

In case of suspension of work from any cause whatever, the Contractor shall be responsible for all materials and shall store them properly if necessary and shall provide suitable drainage and erect temporary structures where necessary.

4-10 DELAYS AND EXTENSION OF TIME

The Contractor may be entitled to an extension of Contract time if the work has been suspended pursuant to the preceding article, in whole or in part, or where other conditions occur which delayed progress and which are clearly beyond the control of the Contractor, provided that in either case the Contractor is not at fault and is not negligent under the terms of the Contract. Extension of time shall be as determined by the Owner.

To receive consideration, a request for extension of time must be made in writing to the Engineer stating the reason for said request, and such request must be received by the Engineer within four (4) days following the end of the delay-causing condition.

The Owner shall ascertain the facts and the extent of the delay, and its findings of the facts thereon shall be final and conclusive. Attention is directed to the nearest weather bureau station in the vicinity of the Work for determining the extremes of temperature, wind velocities, and the amount and intensity of precipitation that can be expected. Weather conditions that have occurred within the three years prior to contract award will not be classified as severe weather conditions for granting extensions of time.

An extension of time may be granted by the Owner after the expiration of the time originally fixed in the Contract or as previously extended, and the extension so granted shall be deemed to commence and be effective from the date of such expiration. Any extension of time shall not release the sureties upon any bond required under the Contract.

4-11 TERMINATION FOR BREACH OF CONTRACT

If the Contractor refuses or fails to prosecute the work or any separable part thereof with such diligence as will ensure its completion within the time specified herein, or any extension thereof, or fails to complete such work within time, or if he or any of his subcontractors should violate any of the provisions of the Contract, the Owner may serve written notice upon the Contractor and his surety of their intention to terminate the Contract, said notice to contain the reasons for such intention to terminate the Contract, and unless within ten (10) days after the service of such notice such violations shall cease and satisfactory arrangements for the corrections thereof be made, the Contract shall, upon the expiration of said ten (10) days cease and terminate.

In the event of any such termination, the Owner shall immediately serve written notice thereof upon the Surety and the Contractor, and the Surety shall have the right to take over and perform the contract; provided, however, that if the Surety within fifteen (15) days after the serving upon it of a notice of termination does not give the Owner written notice of his intention to take over and perform the Contract, or does not commence performance thereof within thirty (30) days from the date of serving said notice, the Owner may take over the work and prosecute the same to completion by contract or by any other method the Owner may deem advisable for the account and at the expense of the Contractor, and his surety shall be liable to the Owner for any excess cost or other damage occasioned the Owner thereby, and in such event the Owner may, without liability for so doing, take possession of and utilize in completing the work such materials, appliances, plants and other property belonging to the Contractor that may be on the site of the work and be necessary therefor. For any portion of such work that the Owner elects to complete by furnishing employees, materials, tools and equipment, the Owner shall be compensated for such in accordance with the schedule of compensation for force account work in the section on payment for changes in the work.

The foregoing provisions are in addition to and not in limitation of any other rights or remedies available to the Owner.

4-12 METHODS AND APPLIANCES

The methods and equipment adopted by the Contractor shall be such as will secure a satisfactory quality of work and will enable the Contractor to complete the work in the time agreed upon. The selection and use of these methods and appliances is the responsibility of the Contractor.

4-13 DATE OF ACTUAL COMPLETION

The date upon which the project will be considered as complete shall be that date upon which the work is accepted by the Owner.

4-14 FINAL ACCEPTANCE

After the Contractor has completed to the best of his knowledge all the work under this Contract, including all of the Contractor's testing and cleanup, the Contractor shall then inform the Engineer by written memorandum that the work has been completed. The Contractor shall then request a final inspection by the Engineer. The Engineer will then make an inspection. If items are found by the Engineer to be incomplete or not in compliance with the Contract requirements, the Engineer will inform the Contractor of such items. After the Contractor has completed these items, the procedure shall then be the same as specified above for the Contractor's statement of completion and request for final inspection.

After all work under the Contract has been completed, as determined by the Engineer, and after the Owner's final seven-day (7-day) test operation if such is required, the Engineer will recommend in writing to the Owner that final acceptance of the entire work under this Contract be made as of the date of the Engineer's final inspection. The Owner will make final acceptance promptly after receiving the Engineer's recommendation.

Unless otherwise specified under Special Conditions, no partial acceptance of any portion of the work will be made and no acceptance other than the final acceptance of the overall completed project will be made. No inspection or acceptance pertaining to specific parts of the project shall be construed as final acceptance of any part until the overall final acceptance by the Owner is made.

4-15 CONSTRUCTION SAFETY PROGRAM AND REGULATIONS

The Utah Occupational Safety and Health Act and the conditions set forth in the Occupational Safety & Health Standards (OSHA) shall constitute the outline for the Safety program to be adhered to during the course of the project. A copy of these publications shall be available at the jobsite for reference.

4-16 TRAFFIC CONTROL

Traffic control shall be as specified under Special Conditions.

4-17 SANITATION

The Contractor shall provide suitable and adequate sanitary conveniences for the use of all persons employed on the project. All sanitary conveniences shall conform to the regulations of the public authority having jurisdiction over such matters. At the completion of the project, all such sanitary conveniences shall be removed and the premises left in a sanitary condition.

4-18 WATER

The Contractor shall supply adequate pure cool drinking water with individual drinking cups for the use of employees on this construction. The quality of drinking water shall meet the "Standards for Public Water Supplies" specified in the State Health Department Code.

It shall be the responsibility of the Contractor to provide and maintain at his own expense an adequate supply of water for his use for construction and to install and maintain necessary supply connections and piping for same. Before final acceptance of the completed project, all temporary connections and piping installed by the Contractor shall be removed.

The Contractor shall apply for a fire hydrant meter and pay for all construction water used at the current rates charged by the Owner or public utility, if the Contractor desires to obtain water from the distribution system at any point.

4-19 PROTECTION OF WORK AND CLEANING UP

The Contractor shall be responsible for the protection of all work until its completion and final acceptance, and he shall at his own expense, replace damaged or lost material, or repair damaged parts of the work, and the Contractor and his Sureties shall be liable therefor.

The Contractor shall remove from the vicinity of the completed work all plant, surplus material, or equipment belonging to him or used under his direction during construction. All surplus excavated material, concrete, plaster, and debris of all kinds shall be removed from the Owner's premises, streets, or portions of building or property at or adjacent to the site of the work excepting that select material which may be required for refilling or grading the surface. Salvage material shall be stored at areas designated by the Engineer. Where an area is indicated to be "cleared," all weeds, vegetation, shrubs, and trees shall be removed unless they are specifically noted as not to be removed.

4-20 GUARANTEE OF WORK

The Contractor shall guarantee the work against defective materials or workmanship for a period of one (1) year from the date of its final acceptance under this Contract except where longer guarantee periods are specifically stated. It shall be the Contractor's responsibility to insure himself that manufacturer and supplier warranties are in compliance with the terms of these Contract Documents.

All work which has been rejected shall be remedied, or removed and replaced, by the Contractor at his own expense, with work conforming to the Plans and Specifications. Any defective material or workmanship which may be discovered before final acceptance or within one (1) year thereafter shall be corrected immediately by the Contractor at his own expense, notwithstanding that it may have been overlooked in previous inspections and estimates. Failure to inspect work at any stage shall not relieve the Contractor from any obligation to perform sound and reliable work as herein described. It is the Contractor's ultimate responsibility to deliver at the time of final acceptance a complete project that complies in all details with these Contract Documents. All items shall be ready to operate.

Any omission or failure on the part of the Engineer to discover or notify the Contractor of or to condemn defective work or material at the time of construction shall not be deemed an acceptance, and the Contractor will be required to correct defective work or material prior to final acceptance.

The Engineer will endeavor to locate any errors or defective materials or workmanship and call them to the attention of the Contractor prior to subsequent work being performed. However, the Engineer is under no obligation to do so and neither the Owner nor the Engineer shall be held liable because errors or defective material or workmanship by the Contractor are not discovered by the Engineer prior to subsequent work.

During the one (1) year guarantee period, should the Contractor fail to remedy defective material and/or workmanship, or to make replacements within five (5) days after written notice by the Owner, it is agreed that the Owner may make such repairs and replacements and the actual cost of the required labor and materials shall be chargeable to and payable by the Contractor.

In the event it is necessary for the Owner to file suit to enforce any liability of the Contractor pursuant to this section GUARANTEE OF WORK, the Owner shall be entitled to recover from the Contractor, in addition to all other amounts found due and owing, a reasonable sum as and for attorney fees.

4-21 CONTINGENCIES

All loss or damage arising from obstruction or difficulties which may be encountered in the prosecution of the work, from the action of the elements, or from any act or omission on the part of the Contractor or any person or agent employed by him shall be borne by the Contractor.

4-22 LIQUIDATED DAMAGES

It is agreed by the parties to the Contract that in case all the work called for under the Contract is not completed before or upon the expiration of the time limits set forth in the Contract Documents, damage will be sustained by the Owner, and that it is and will be impracticable to determine the actual damage which the Owner will sustain in the event of and by reason of such delay, and it is therefore agreed that the Contractor will pay to the Owner an amount specified in the Special Conditions for each calendar day between the completion date required by the Contract, and the date of final acceptance by the Owner, as

liquidated damages and not as penalty. It is further agreed that the amounts stipulated are reasonable estimates of the damages that would be sustained by the Owner and the Contractor agrees to pay such liquidated damages as herein provided. In case the liquidated damages are not paid, the Contractor agrees that the Owner may deduct the amount thereof from any money due to or that may become due the Contractor by progress payments or otherwise under the Contract, or if said amount is not sufficient, recover the total amount.

The Contractor shall not be assessed with liquidated damages during any delay in the completion of the work caused by acts of God, acts of criminals, acts of the Owner, acts of the public utilities, fire, floods, epidemics, quarantine restrictions, labor strikes that delay the critical sequence of the work, and unusually severe weather or delays of subcontractors due to such causes, provided that the Contractor shall notify the Owner in writing the causes of such delay as stated hereinbefore.

4-23 NOTICE AND SERVICE THEREOF

Any Notice to the Contractor from the Owner relative to any part of this Contract shall be in writing and considered delivered and the service thereof completed when said Notice is posted, by Registered mail, to the said Contractor at his last given address, or delivered in person to said Contractor or his authorized representative on the work.

* * * END OF GENERAL CONDITIONS - PART 4 * * *

GENERAL CONDITIONS - PART 5

SCOPE OF WORK

5-1 INTENT OF PLANS AND SPECIFICATIONS

The intent of the Plans and Specifications is to prescribe a complete work or improvement which the Contractor shall perform in a manner acceptable to the Engineer and in full compliance with the terms of the Contract. The Contractor shall provide the Owner with a complete and operable work or improvement, even though the Plans and Specifications may not specifically call out all items or items of work required of the Contractor to complete his tasks, incidental appurtenances, materials, and the like.

The Contractor shall perform the work in accordance with the lines, grades, cross sections, and dimensions indicated on the Plans and detailed drawings.

Unless otherwise specified in the Special Conditions, the Contractor shall furnish all materials, labor, tools, equipment, water, light, power, transportation, superintendence, temporary construction of every nature, and incidentals, including, but not limited to, dust and traffic control measures, and to perform all work involved in executing the Contract in a satisfactory and workmanlike manner within the time specified.

5-2 CHANGES IN THE WORK

The Owner, without invalidating the Contract and without notification of Sureties, may order extra work, make changes by altering, or delete any portion of the work as specified herein, or as deemed necessary or desirable by the Owner. All such work shall be executed under the conditions of the original Contract except that any claim for extension of time and additional costs caused thereby shall be adjusted at the time of ordering such change or extra work.

Any additional work required beyond the original scope of this contract, considered 'extra work,' will only be executed upon a written change order signed by both parties. Such a combination of extra work, not exceeding 20% of the original total project cost, will be compensated at a rate matching previous pricing per similar item of the original Contractor Bid, with detailed cost breakdowns provided to the Client prior to commencement of any extra work, unless otherwise mutually agreed upon in writing.

In giving instructions, the Engineer shall have authority to make minor changes in the work, not involving extra cost, and not inconsistent with the purposes of the work. No extra work or change shall be made unless in pursuance of a written order by the Engineer, and no claim for an addition to the total amount of the Contract shall be valid unless so ordered, except in an emergency endangering life or property.

It is mutually understood that it is inherent in the nature of municipal construction that some changes in the Plans and Specifications may be necessary during the course of construction to adjust them to field conditions, and that it is of the essence of the Contract to recognize a normal and expected margin of change. The Owner shall have the right to make such changes, from time to time, in the Plans, in the character of the work, and in the termination of the project as may be necessary or desirable to ensure the completion of the work in the most satisfactory manner without invalidating the Contract.

Any change ordered by the Owner which involves installation of work essential to complete the Contract, but for which no basis of payment is provided for herein, said payment therefore shall be subject to negotiation.

Upon demand of either the Contractor or the Owner an equitable adjustment satisfactory to both parties shall be made in the basis of payment for extra work. The prices agreed upon and any agreed upon adjustment in Contract time shall be incorporated in the written order issued by the Owner, which shall be written so as to indicate acceptance on the part of the Contractor as evidenced by his signature. In the event prices cannot be agreed upon, the Owner reserves the right to terminate the Contract as it applies to the items in question and make such arrangements as it may deem necessary to complete the work, or it may direct the Contractor to proceed with the items in question on a force account basis as provided hereinafter.

5-3 FORCE ACCOUNT

LABOR: For all labor and for foremen in direct charge of the specific operations the Contractor shall be paid:

The actual cost of wages paid by him but at rates not to exceed those for comparable labor currently employed on the project.

The actual cost of industrial accident or Workmen's Compensation Insurance.

The actual cost of social security taxes and unemployment compensation insurance.

The actual amounts paid by the Contractor by reason of an employment Contract generally applicable to his employees.

An amount equal to fifteen percent (15%) of the actual cost of wages and other costs listed above to cover the Contractor's profit and overhead.

In case work is performed by a subcontractor, the said fifteen percent (15%) will be added only once to the actual cost of the work, however, the Contractor may add ten percent (10%) to the Subcontractor's price to cover his own overhead.

TOOLS AND EQUIPMENT: For any machine power tools and special or heavy equipment used, the Contractor shall be paid in accordance with the latest approved Schedule of Equipment Rental Rates. In the event that any of the equipment to be used is not shown in said schedule, the rental rate for such equipment shall be as agreed upon in writing before the work is started. No percentage shall be added to equipment rental rates and no allowance shall be made for the use of small tools and minor items of equipment which shall be considered as part of the overhead. As used herein, such tools and equipment are defined as individual tools or pieces of equipment having a replacement value of Fifty Dollars (\$50.00) each or less.

MATERIALS: For all materials accepted by the Engineer and used in the work the Contractor shall be paid the actual cost of such material, including transportation charges, to which cost shall be added a sum equal to fifteen percent (15%) thereof.

SUPERVISION AND OVERHEAD: No allowance shall be made for general superintendence. The cost of supervision and overhead is presumed to be included in the fifteen percent (15%) added in accordance with the above.

RECORDS: The Contractor's representative and the Engineer shall compare the records of the work performed as ordered on a force account basis as the end of each day on which such work is performed. Copies of these records shall be made on suitable forms provided for this purpose and signed by both the Engineer and the Contractor's representative. All claims for work done on a force account basis shall be certified and submitted to the Engineer by the Contractor, and such statements shall be filed with the Engineer not later than the fifth (5th) day of the month following that in which the work was actually performed.

5-4 EXTRA WORK

New or additional work will be classified as extra work when determined by the Engineer that such work is not covered by the Contract.

5-5 CHANGE ORDERS

The value of such work or change shall be determined and paid for with a Change Order in one of the following ways unless paid by force account:

By unit prices mutually agreed upon by the Owner and Contractor

By a lump sum based upon the Contractor's estimate and the Engineer's review and acceptance of the estimate. The Contractor shall do such extra work and furnish material and equipment therefor upon receipt of an accepted Contract Change Order or other written order of the Owner, and in the absence of such Contract Change Order or other written order of the Owner, the Contractor shall not be entitled to payment for such extra work. Payment for extra work required to be performed

pursuant to the provisions of this section, in the absence of an executed Contract Change Order, will be made by force account as provided herein, or as agreed to by the Contractor and the Owner. However, in no case shall work be undertaken without written notice from the Owner to proceed with the work.

If the sum of the change orders has not exceeded 20% of the cost of the project as a whole, then the Contractor shall submit pricing for each change order not exceeding the original pricing per item/manhours as was provided in the original Contractor Bid.

Change orders, once exceeding 20% of the original Contractor Bid shall be subject to methods specified in CHANGE ORDERS and CHANGES IN THE WORK.

5-6 CLAIMS FOR EXTRA WORK

If the Contractor claims that any instructions involve extra cost under this Contract, he shall give the Owner written notice thereof within forty-eight (48) hours after the receipt of such instructions, and in any event before proceeding to execute the work, except in emergency endangering life or property, and the procedure shall then be as provided for under CHANGES IN THE WORK. No such claim shall be valid unless so made.

* * * END OF GENERAL CONDITIONS - PART 5 * * *

GENERAL CONDITIONS - PART 6

CONTROL OF WORK

6-1 WORK SCHEDULE

Prior to the commencement of the work the Contractor shall prepare and submit to the Engineer for review, a written schedule covering the general sequence of the work to be performed. The work schedule, after review and acceptance by the Engineer, shall not be changed without written consent of the Engineer. The Contractor shall assume the full responsibility for performing the work in an orderly procedure under the Contract.

The construction schedule shall serve as an index of progress prosecution as contemplated by the Contractor. In the event the actual construction progress varies substantially from the scheduled progress, the Engineer will require and the Contractor shall be required, within ten (10) days written notice, to provide a revised construction schedule, giving in detail the particular changes in production as estimated by the Contractor to complete the work within the specified Contract Time. Time is of the essence in this regard.

6-2 AUTHORITY OF THE ENGINEER

The Engineer will decide all questions which may arise as to the quality and acceptability of materials furnished and work performed; all questions which may arise as to the interpretation of the Plans and Specifications; and all questions as to the satisfactory and acceptable fulfillment of the Contract on the part of the Contractor.

Written permission must be obtained from the Engineer to perform any work after regular hours, on Sundays, or on legal holidays. Work performed at these times shall be done at no additional expense to the Owner.

6-3 FORMAL PROTEST

If the Contractor considers any work demanded of him to be outside the requirements of the Contract, or if he considers any instructions, ruling, or decision of the Engineer to be unfair, he shall, within ten (10) days after any such demand is made, or instruction, ruling or decision is given, file a written protest with the Engineer, stating clearly and in detail his objections and the reasons therefor. Except for such protests as are made of record in the manner and within the time above stated, the Contractor shall be deemed to have waived and does hereby waive all claims for Extra Work, damages and extensions of time resulting from demands, instructions, rulings and decisions of the Engineer.

Upon receipt of any such protest from the Contractor, the Engineer shall review the demand, instructions, rulings, or decisions objected to and shall promptly advise the Contractor in writing of his final decision, which shall be binding, unless within ten (10) days thereafter the Contractor shall file with the Owner a formal protest against said final decision of the Engineer.

The Owner shall consider and render a final decision of any such protest within thirty (30) days of receipt of same.

6-4 PLANS

The Contract Plans consist of general drawings. These indicate such details as are necessary to give a comprehensive idea of the construction contemplated. All authorized alterations affecting the requirements and information given on the Contract Plans shall be in writing. The Contract Plans shall be supplemented by such working or shop drawings prepared by the Contractor as are necessary to adequately control the work. No change shall be made by the Contractor in any working or shop drawing after it has been accepted by the Engineer.

The Contractor shall keep a copy of the Plans and Specifications at the jobsite, and shall at all times give the Engineer access thereto. Any drawings or plans listed in the Detailed Specifications shall be regarded as a part thereof and the Engineer will furnish from time to time such additional drawings, plans, profiles, and information as he may consider necessary for the Contractor's guidance.

All authorized alterations affecting the requirements and information given on the accepted Plans shall be in writing. No changes shall be made of any Plan or drawing after the same has been accepted by the Engineer, except by consent of the Engineer in writing.

6-5 CONFORMITY WITH PLANS AND ALLOWABLE DEVIATIONS

Finished surfaces in all cases shall conform with lines, grades, cross sections, and dimensions shown on the accepted Plans. Allowable deviations, other than specified tolerances, from the accepted Plans and working drawings will in all cases be determined by the Engineer.

6-6 COORDINATION AND INTERPRETATION OF PLANS AND SPECIFICATIONS

The Plans, Specifications, General Conditions, Special Conditions, Contract Change Orders, and all supplementary documents are essential parts of the Contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be coordinated and to describe and provide for a complete work.

Should it appear that the work to be done or any of the matters relative thereto are not sufficiently detailed or explained in these Specifications, General Conditions, Special Conditions, or the Plans, the Contractor shall apply to the Engineer for such further explanations as may be necessary and shall conform to them

as part of the Contract. In the event of any doubt or question arising regarding the true meaning of these Specifications, the Special Conditions, or the Plans, reference shall be made to the Engineer, whose decision thereon shall be final. In the event of any discrepancy, between any drawing and the figures written thereon, the figures shall be taken as correct.

In the event of there being a conflict between one Contract Document and any of the other Contract Documents, the Document highest in precedence shall control and supersede the Document which is contrary to it. The order of precedence of the Contract Documents is as follows:

FIRST: Supplemental Agreements, the last in time being the first in precedence.

SECOND: The formal Contract.

THIRD: Notice Inviting Bids.

FOURTH: Information for Bidders.

FIFTH: Special Conditions (DIVISION 1).

SIXTH: Specifications (DIVISIONS 2 through 15).

SEVENTH: PLANS.

EIGHTH: Supplemental General Conditions (when included).

NINTH: General Conditions.

TENTH: Contractor Proposal.

6-7 ORDER OF WORK

When required by the Contract Documents, the Contractor shall follow the sequence of operations as set forth therein.

Full compensation for conforming with such requirements will be considered as included in the prices paid for Contract items of work and no additional compensation will be allowed therefor.

6-8 INSPECTION

The Contractor shall furnish the Engineer with every reasonable facility for ascertaining whether or not the work as performed is in accordance with the requirements and intent of the Specifications and Contract. If the Engineer requests it, the Contractor at any time before acceptance of the work shall

remove or uncover such portions of the finished work as may be directed. After examination, the Contractor shall restore said portions of the work to the standards required by the Specifications. Should the work thus exposed or examined prove acceptable, the uncovering or removing and the replacing of the covering or making good of the parts removed, will be paid for as provided under CHANGES IN THE WORK, but should the work so exposed or examined prove unacceptable the uncovering or removing and the replacing of the covering or making good of the parts removed shall be at the Contractor's expense. Inspection or supervision by the Engineer shall not be considered as direct control of the individual workman and his work. The direct control shall be solely the responsibility of the Contractor's foremen and superintendent. When the United States Government is to pay a portion of the cost of the work covered by the Contract, the work shall be subject to the inspection of the representatives of the U. S. Government. Such inspection shall in no sense make the U. S. Government a party to this Contract and will in no way interfere with the rights of either party under this Contract.

The inspection of the work shall not relieve the Contractor of any of his obligations to fulfill his Contract as herein provided, and unsuitable materials may be rejected notwithstanding that such work and materials may have been previously overlooked and accepted or estimated for payment.

Should any work be covered up before acceptance or consent of the Engineer, it must, if required by the Engineer, be uncovered for examination at the Contractor's expense.

6-9 LINES AND GRADES

Profiles and elevations are indicated on the Plans. Elevations are referred to a datum as indicated on the Plans. All work under this Contract shall be built in accordance with the lines and grades indicated on the Plans. These lines and grades may be modified as provided in the Contract. The establishment of the lines and grades shall be as set forth under Special Conditions.

* * * END OF GENERAL CONDITIONS - PART 6 * * *

GENERAL CONDITIONS - PART 7

MATERIALS AND WORKMANSHIP

7-1 GENERAL

All equipment, materials, and articles incorporated in the work covered by this Contract shall be new and subject to review and acceptance by the Engineer unless otherwise specifically provided for in the Contract Documents.

Where equipment, materials, or articles are referred to in the Specifications as "or equal," or "equal to" any particular standard, the Engineer shall decide the question of equality.

Wherever any standard published specification is referred to, the latest edition or revision, including all amendments, shall be used unless otherwise specified. Materials of a general description shall be the best of their several kinds, free from defects, and adapted to the use for which provided. The physical characteristics of all materials not particularly specified shall conform to the latest standards published by the American Society for Testing and Materials, where applicable. All material shall be new and of the specified quality and equal to the accepted samples, if samples have been submitted.

All work shall be done and completed in a thorough, workmanlike manner notwithstanding any omission from these Specifications or from the Plans; and it shall be the duty of the Contractor to call the Engineer's attention to apparent errors or omissions and request instructions before proceeding with the work. The Engineer may, by appropriate instructions, correct errors and supply omissions, which instructions shall be as binding upon the Contractor as though contained in the original Specifications or Plans.

7-2 SUBSTITUTION OF MATERIAL OR EQUIPMENT

Where material or equipment is designated on the Plans or in the Specifications by a trade or manufacturer's name, it is so designated primarily to establish standards of quality, finish, appearance, and performance. It is not the intent to limit the choice of materials and equipment to the specific product designated. However, requests relative to substitutions for materials or equipment specifically designated on the Plans and in the Specifications will not be considered until after award of the Contract. Requests relative to substitutions for materials or equipment specifically designated on the Plans or in the Specifications shall be made in writing, and such requests shall be accompanied by complete data on which the Engineer can make determination on the merits of the proposed substitution. The written request shall state how the product proposed for a substitution compares with or differs from the designated product in composition, size, arrangement, performance, etc., and in addition, the request shall be accompanied by documentary evidence of equality in price and delivery or evidence of difference in price and delivery. Data on price shall be in the form of certified quotations from suppliers of both the

designated and proposed items. All items accepted for substitution shall be subject to all applicable provisions of the Specifications. All specific requirements of the Specifications must be adhered to, and all necessary modifications shall be made in the articles specified by trade name, type, or model of manufacturer's equipment to make it conform to the specific requirements of the Specifications and the actual conditions under which the product is required to be used. Should a substitution be allowed under the foregoing provisions, and should the item subsequently prove to be defective or otherwise unsatisfactory for the service for which it was intended, the Contractor, shall without cost to the Owner, and without obligation on the part of the Engineer, replace the item with the material originally specified.

7-3 SAMPLE AND TESTING

All materials to be incorporated in the work shall be subject to sampling, testing, and acceptance. Samples furnished by the Contractor shall be representative of the materials to be used. The Engineer may select samples or may require that samples be delivered to and tested at a laboratory designated by the Engineer at no additional cost to the Owner.

All sampling and testing of materials shall be done in accordance with the latest designated standard methods of AASHTO or ASTM, or in accordance with special methods designated in the Specifications.

Sieves used in determining the grading of samples of aggregates, select material, and other graded materials, shall conform to ASTM Designation E 11. Sieves 1/4-inch and larger shall have square openings and are designated by the size of opening in inches. Sieves smaller than 1/4-inch shall have square openings and are designated by number.

7-4 FABRICATED MATERIALS AND SHOP DRAWINGS

Fabricated materials and shop drawings shall be handled as set forth in the Special Conditions.

7-5 MATERIALS FURNISHED BY THE OWNER

All materials and/or services furnished by the Owner shall be obtained by the Contractor as indicated in the Special Conditions. The cost of handling and placing Owner furnished materials shall be included in the price paid for the Contract item involving such material.

7-6 STORAGE OF MATERIALS

The Contractor shall provide proper storage facilities and exercise such measures as will insure the preservation of the specified quality and fitness of all materials and equipment to be used in the work. Stored materials shall be located so as to provide reasonable access for inspection. That portion of the right-of-way not required for public travel may be used for storage purposes unless prohibited by other provisions of the project Specifications. Any additional space required shall be provided by the Contractor at no cost to the Owner. Protection of materials and equipment stored on the site shall be the

responsibility of the Contractor. The Owner reserves the right to direct the Contractor to provide proper means of protection for materials if such is deemed advisable by the Engineer; however, the exercise of or failure to exercise this right shall not be deemed to relieve the Contractor of his primary responsibility for protecting the material and equipment. The Contractor shall provide suitable warehouses or other adequate means of protection for such of the materials and equipment as require storage or protection. The Contractor shall store and care for the materials and equipment in the most suitable manner to protect them from distortion, rain, dust, or other damage. The cost of replacing any material or equipment damaged in storage shall be borne by the Contractor, and the fact that material or equipment has been damaged after partial payment has been made shall not relieve the Contractor of his primary responsibility. No motor shall be left uncovered or unprotected.

7-7 REJECTED MATERIALS

Materials not conforming to the requirements of the Specifications, whether in place or not, may be rejected. Rejected materials shall be removed immediately from the site of the work unless otherwise permitted by the Engineer. No rejected material, the defects of which have been subsequently corrected, shall be used unless accepted by the Engineer. If the Contractor fails to remove and replace rejected material, the Owner has authority to do so and to deduct the cost thereof from any monies due or to become due the Contractor.

* * * END OF GENERAL CONDITIONS - PART 7 * * *

GENERAL CONDITIONS - PART 8

LEGAL RELATIONS AND RESPONSIBILITY

8-1 LAWS TO BE OBSERVED

The Contractor is presumed to know, and at all times shall observe and comply with, all Federal and State laws and local ordinances, workmen's compensation, occupational disease, and unemployment compensation laws together with the payment of all premiums and taxes therefor; also all laws, ordinances, and regulations in any manner affecting the conduct of the work, and shall indemnify and save harmless the Owner and its representatives against any claim arising from the violation of such laws, bylaws, ordinances, or regulations, whether by the Contractor himself or by the Contractor's employees. The Contractor's particular attention is drawn to the cognizance of, but not limited to, the laws in the four (4) following paragraphs.

8-2 HOURS OF LABOR

Eight (8) hours shall constitute a day's work on all works or undertakings carried on or aided by the State, County or Municipal governments; and the Legislature shall pass laws to provide for the health and safety of employees in factories, smelters, and mines (Section 6, Article XVI, Constitution of the State of Utah).

8-3 ALIEN LABOR

No person not a citizen or ward of the United States shall be employed upon or in connection with any State, County, or municipal works or employment provided that nothing herein shall be construed to prevent the working of prisoners by the State or by any County or municipality thereof on street or road work or other public work.

8-4 LABOR DISCRIMINATION

Attention is directed to Utah Code Annotated, Title 34, Chapter 35, entitled "Utah Antidiscrimination Act."

When Federal funds are to pay a portion of the cost of this project, then the bidders shall also comply with the applicable paragraph in the Special Conditions.

8-5 PERMITS AND LICENSES

Except as otherwise provided in the Specifications it is the duty of the Contractor to procure all permits and licenses, pay all charges and fees, and give all notices necessary and incident to the due and lawful prosecution of the work.

8-6 PATENTED DEVICES, MATERIALS, AND PROCESSES

The Contractor shall indemnify and save harmless the Owner and its duly authorized representatives from all liabilities, judgments, costs, damages, and expenses which may result from the infringement of any patents, trademarks, and copyrights by reason of the use of any proprietary materials, devices, equipment, or processes incorporated in or used in the performance of the work under this Contract.

8-7 SURVEY LAND MONUMENTS

Survey land monuments and property marks shall not be moved or otherwise disturbed by the Contractor until an authorized agent, of the agency having jurisdiction over the land monuments or property marks setting, has witnessed or otherwise referenced their location, and only then in accordance with the requirements of the agency having jurisdiction.

8-8 PROTECTION OF PERSON AND PROPERTY

The Contractor shall adopt every practical means and comply with all laws, ordinances, and regulations in order to minimize interferences to traffic, and inconveniences, discomfort and damage to the public, including the provision of adequate dust control measures. All obstructions to traffic shall be guarded.

If an unsafe condition arises or exists during the progress of the work, or if the Owner has reason to believe that an unsafe condition exists, the Contractor shall suspend the work wholly or in part for such period as may be necessary to correct the unsafe condition.

The Contractor shall not trespass upon private property and shall be responsible for all injury or damage to persons or property, directly or indirectly, resulting from his operations in completing this work. He shall comply with the laws and regulations of the Owner, County, and State, relating to the safety of persons and property, and will be held responsible and required to make good any injury or damage to persons or property caused by carelessness or neglect on the part of the Contractor or subcontractor(s), or any agent or employee of either during the progress of the work and until its final acceptance.

The Contractor shall protect against injury any pipes, sewer conduits, electrical conduits, lawns, gardens, shrubbery, trees, fences, or other structures or property, public and/or private, encountered in this work except as stipulated elsewhere herein. The Contractor shall be responsible and liable for any injury to such pipe, structures, and property.

8-9 UTILITIES SHOWN ON THE PLANS

Regardless of what utilities are shown on the Plans, it shall be the Contractor's responsibility to verify these locations and any additional lines which may exist through consulting with the Owner, utility companies, and/or "Blue Stake."

Existing utilities are indicated on project Plans in accordance with the best information available. The Contractor shall notify all Owners of utilities when his work is in progress and shall make such arrangements as are necessary to make any emergency repair to any utility, in a manner satisfactory to the owner of a damaged utility line, including individual or house service utility lines.

No extra compensation will be made for the repair of any individual or house service utility or utility lines damaged by the Contractor's labor forces or equipment, nor for any damage incurred through neglect or failure to provide protective barriers, lights and other devices or means required to protect such existing utilities.

The Contractor shall expose all sanitary and storm sewers, water, gas, electric, telephone utility lines, and other underground structures which might interfere with the construction of the project, in order to permit survey location prior to construction.

The work necessary to the raising, lowering or relocating of a utility, which work is not so indicated on the Plans shall be at the owner's expense. The necessary work may be done by the owner of the utility or by the Contractor, at the option of the owner of the utility. All work shall be in accordance with the standards of the owner of the utility.

The Contractor shall resolve crossing and clearance problems concerning all utility structures with the utility company concerned.

8-10 UTILITIES NOT SHOWN ON THE PLANS

If utility lines are encountered which are not indicated on the Plans, other than individual or house service utility lines, and which the Owner, utility companies, and/or "Blue Stake" are unaware of their existence, and these lines are damaged or work is required to clear same, then the Contractor will be paid for any extra work involved on his part on a cost plus basis, as set forth elsewhere herein.

In some cases, individual or house service utility lines are not shown on the Plans. It shall be the Contractor's responsibility to locate and protect these individual or house services. If, due to the Contractor's operations, any of these lines are damaged, he shall repair or replace these lines in a manner satisfactory to the owner of the utility at no extra cost to the owner. In addition, the cost of location, protection, and working around these individual or house service utility lines shall be included in the Contractor's bid for the work under this Contract.

8-11 DRIVEWAYS AND WALKS

Inconvenience caused by digging across driveways and sidewalks shall be kept to a minimum by restoring the serviceability of the drive or sidewalk as soon as possible. Before blocking driveways, the Contractor shall notify the property owner. The Contractor shall replace or repair any damage done to

driveways and walks to not less than the condition existing prior to the Contractor's work. If it is necessary to leave an excavation open across driveways or sidewalks, the Contractor shall provide temporary relief in the form of steel plates over the excavation.

Temporary paving replacement in front of business establishments shall be placed immediately following backfill and shall remain in place until the condition of the backfill is suitable for permanent pavement replacement.

Direct access shall be provided at all times to fire engine houses, fire hydrants, hospitals, police stations, and at all other agencies or services where emergencies may require immediate access to same.

8-12 TREES AND SHRUBBERY

All trees and shrubbery within the right-of-way or easements shall be protected by the Contractor insofar as practicable.

In the event shrubbery or trees must be trimmed, or removed, the Contractor shall notify the property owner to do so within a reasonable time prior to construction. All shrubbery or trees not removed by the property owner shall be trimmed or removed by the Contractor and hauled from the job at the Contractor's expense.

All trees, shrubs, hedges, brush, etc. designated on the Plans, or by the Engineer for removal, shall be completely removed and disposed of as indicated on the Plans or specified.

8-13 IRRIGATION DITCHES AND STRUCTURES

The Contractor shall contact the owners of any ditches, irrigation lines, and appurtenances which interfere with the work and shall make arrangements for dry-up or scheduling of water deliveries. The Contractor shall be liable for any damage due to irrigation facilities damaged by his operations and shall repair such damaged facilities to an "equal or better than" original condition.

8-14 ROADS AND FENCES

Streets and roads subjected to interference by the prosecution of this work shall be kept open and maintained by the Contractor until the work is completed.

All fences located in easements, when damaged or temporarily removed, shall be restored to a condition equal to or better than the original condition. Such fences shall be restored at the Contractor's expense.

8-15 PROTECTION OF ANTIQUITIES

Attention is called to State and Federal laws pertaining to the protection and preservation of sites or objects of archaeological, anthropological, paleontological or historic interest.

It shall be a provision of every contract that when features of archaeological, anthropological, paleontological or historic interest are encountered or unearthed in material pits, the roadway prism, or other excavation the Contractor shall stop work in the immediate vicinity of such feature, protect it from damage or disturbance, and report promptly to the State and local officials having jurisdiction.

Work shall not be resumed in the immediate area until the Contractor is advised by the authorities having jurisdiction that study or removal of the feature or features has been completed. The Contractor will be allowed an appropriate contract time extension as provided in these GENERAL CONDITIONS for construction time lost.

8-16 RESPONSIBILITY FOR DAMAGE CLAIMS

The Contractor and his Surety shall indemnify and save harmless the Owner and its officers, agents, and representatives from all suits, actions, loss, damage, expense, costs, or claims of any character or nature brought on account of any injuries or damages sustained by any person or property arising out of the work done in fulfillment of the construction of the improvement under the terms of this agreement, or on account of any act of omission by the Contractor or his agents, or from any claims or amounts arising or recovered under workmen's compensation laws or any other law, bylaw, or ordinance, order, or decree.

8-17 NONRESPONSIBILITY OF THE OWNER

Indebtedness incurred for any cause in connection with this work must be paid by the Contractor, and the Owner is hereby relieved at all times from any indebtedness or claim other than payments under terms of the Contract.

8-18 PROPERTY RIGHTS IN MATERIAL

Nothing in the Contract shall be construed as vesting in the Contractor any right of property in the material used after they have been attached or affixed to the work or the soil and accepted. All such materials shall become the property of the Owner upon being so attached or affixed and accepted.

*** END OF GENERAL CONDITIONS - PART 8 ***

GENERAL CONDITIONS - PART 9

PAYMENT TO CONTRACTORS

9-1 GENERAL

The basis of payment for construction of a project shall be in full for all work actually performed in accordance with the Plans and Specifications, and shall include all labor and materials incorporated in the completed work.

Upon final inspection and acceptance of the work, the Owner will pay the Contractor the amount earned under the Contract, as stipulated herein.

9-2 PAYMENT

For and in consideration of the faithful performance of the work, the Owner will pay to the Contractor the amount earned as computed from the actual quantities of work performed under the Contract and to make such payment in the manner and at the time(s) specified, as follows:

Within thirty (30) days after final acceptance of the work completed under the Contract, the Engineer shall render to the Owner and to the Contractor, a final estimate which shall show the amount of work performed according to the Contract. Within forty (40) days after the final completion and final acceptance of the work under the Contract, the Owner will pay to the Contractor all amounts due him under the provisions of the Contract, except that before the final payment will be made, the Contractor shall satisfy the Owner by affidavit that all bills for labor and materials incorporated in the work have been paid, and shall complete and submit to the Engineer a Certification relinquishing any and all claims or right of lien under, in connection with, or as a result of the work under the Contract.

The basis of payment shall be in full for all work actually performed in accordance with these Specifications, and shall include all labor and materials incorporated in the completed work.

9-3 PARTIAL PAYMENT

Once each month the Owner will make a partial payment to the Contractor on the basis of an estimate prepared by the Contractor and accepted by the Engineer for work completed through the last day of the preceding calendar month. The estimate will cover the work performed by the Contractor during the preceding calendar month plus the invoice cost of material suitably stored at the site of the project if the Contractor desires payment for material stored. The Owner will retain 5 percent (5%) of the amount of each such estimate and material cost until final completion and acceptance of all work covered by this Contract.

Cost of material stored will be based on vendors' invoices which shall be listed by the Contractor. A copy

of each such invoice shall accompany the first estimate in which payment is requested for material covered by the invoice. This list shall be revised and brought up-to-date by the Contractor for each estimate. The revised list shall show the total amount of each invoice, the invoice amount that has been incorporated in the work, and the remaining invoice amount that is stored for which payment is requested that month. Only those materials that will become an integral part of the final completed project may be included for partial payment as material stored.

If required by the Proposal or Special Conditions, the Contractor shall furnish a detailed breakdown of the lump sum Contract Price, showing unit prices and quantities for use in preparing the monthly estimate. No partial payment will be made until this breakdown is presented by the Contractor and has been reviewed and accepted by the Engineer.

Partial payments for jobsite delivered material or equipment will in no way reduce the Contractor's responsibility for such material or equipment until it has been installed.

9-4 PAYMENT OF ITEMS IN PROPOSAL

Only those items listed in the Proposal are Pay Items.

Compensation for all work necessary for the completion of the project or improvement shall be included by the bidder in the price bid for the items shown in the Proposal.

9-5 PAYMENT FOR "EXTRA WORK" AND FOR "CHANGES IN THE WORK"

Payment for "Changes in the Work" and for "Claims for Extra Work" will be made as stated in Part 5 of these GENERAL CONDITIONS.

* * * END OF GENERAL CONDITIONS - PART 9 * * *

DIVISION 1

SPECIAL CONDITIONS

010010 PROJECT DESCRIPTION

It is the Owner's intent to construct the Heritage Park Booster Pump Station in Orem, Utah.

010011 SUMMARY OF WORK

The work, in general, consists of the following:

Construction of a 12,000 GPM culinary water booster pump station. Work includes a new masonry building, vertical turbine pump and motors w/ pump cans, pump discharge and pressure relief piping, in-room overhead crane within booster pump station, site piping, heating and ventilation, site work - both on the direct booster pump station site, tying the booster station site into the adjacent tank site, adding a right-hand-turn lane to the adjacent road (400 S), and adding finishing asphalt lift to 400 S between 600 W and 400 S , electrical, and site protection via jersey barrier placement as required. Other work pertinent to these improvements is shown on the Plans.

010012 LOCATION OF PROJECT

The Heritage Park Booster Pump Station project is located at 415 West 400 South Orem, Utah.

010014 WORK BY OTHERS

The Owner, utilities, and others may be working within the project area while the Work is in progress. If so, the Contractor shall schedule his work in conjunction with these other organizations to minimize mutual interference.

The Contractor shall cooperate to make the necessary connections at a minimum cost and time delay for all involved. In the event of lack of agreement, the Engineer will determine how and where the interface will be made, and his decision shall be final.

010016 RESPONSIBILITY OF CONTRACTOR

If any part of the Work depends on proper execution or results upon the work of others, the Contractor shall inspect and promptly report to the Engineer any apparent discrepancies or defects in such work of others that render it unsuitable for such proper execution and results. Failure of the Contractor to so inspect and report shall constitute an acceptance of the work of others as fit and proper except as to defects which may develop in the work of others after execution of the Work by the Contractor.

010017 WORK INVOLVED WITH EXISTING PIPELINES

The Contractor shall notify the Engineer of the Contractor's planned procedure for each specific alteration of existing facilities before the alteration begins. The Contractor shall not begin an alteration until specific permission has been granted by the Owner in each case. The Engineer will coordinate the Contractor's planned procedure with the Owner. The making of connections to existing facilities or other operations that interfere with the operation of the existing equipment shall be completed as quickly as possible and with as little delay as possible.

Any operational functions of the existing pipelines that are required to be done to facilitate Contractor's operation will be done by the Owner's personnel only.

The Owner's operation and maintenance personnel will cooperate in every way that is practicable in order to expedite Contractor's operation; however, if it is necessary for the proper operation or maintenance of portions of the existing pipelines, the Contractor shall reschedule his operations so there shall be no conflict with necessary operations or maintenance of the system.

Existing materials and equipment removed in the execution of the Work and designated as salvageable in the Contract Documents or by the Engineer, shall remain the property of the Owner. All reasonable effort shall be made to remove and preserve such material and equipment in an undamaged condition, and it shall be stored at the Work site as the Engineer may direct.

010018 COORDINATION OF WORK

The Contractor shall maintain overall coordination for the execution of the Work. Based on the Construction Schedule prepared in accordance with these Specifications, he shall obtain from each of his subcontractors a similar schedule and shall be responsible for all parties maintaining these schedules or for coordinating required modifications.

010019 WORK SEQUENCE AND CONSTRAINTS

1. The Contractor shall obtain all necessary permits from Orem City before beginning construction including a building permit from the Building Department. The Owner will pay all fees associated with the permits. The Contractor shall comply with all provisions associated with the permits.
2. The Contractor shall have any portion of the project(s) blue staked 48 hours before digging.
3. The Contractor shall pothole all utilities and field verify locations of existing piping prior to making connections and crossings.
4. The Contractor shall protect the site from storm water runoff. The City's storm drain system shall also be protected from discharges of silt, dirt, or dirty water. The Contractor shall comply with the storm water protection details included in the Plans as well as with any additional provisions required by the City's permits, state laws, or Federal Laws.
5. All roads shall be protected from mud and debris and kept clean and swept during the course of construction.
6. All submittals for materials and equipment shall be submitted, as a minimum, within 30 calendar days from the effective date of the Notice to Proceed. Progress payment invoices shall be subject to the providing of submittals per Section 010322 SUBMITTALS.
7. The Contractor shall coordinate with the power and gas companies for the installation of these utilities as indicated on the Plans. The portion of this work to be completed by the Contractor is shown on the Plans. Any direct costs from the utility companies will be paid for by the Owner.
8. The Contractor shall coordinate the use of water for testing purposes of the various aspects of the project with the City.

9. Due to the size and complexity of this project, several contractors will be working on site simultaneously. Connection points between the various projects have been identified on the plans. The contractor shall be responsible for coordinating with the other contractors to verify that connections can be completed as per their anticipated schedule. Any discrepancies shall be brought to the engineer well in advance of the construction date.

010020 CONSTRUCTION STAKES, LINES, AND GRADES

The Work shall be executed in accordance with the lines and grades indicated in the Contract Documents. Distances and measurements, except elevations and structural dimensions, shall be made on horizontal planes.

010020.1 LINES AND GRADE

All work under this Contract shall be built in accordance with the lines and grades as indicated in the Contract Documents. Distances and measurements except elevations and structural dimensions shall be made on horizontal planes.

010021 PROJECT WORK

The Engineer will furnish a basic reference line, a beginning point on this line, and a benchmark from which the Contractor shall establish such other control and reference points as he may need and as will be required to properly lay out the work. Monuments for principal control points shall be set by the Contractor and shall be protected by the Contractor from disturbance. If the monuments are disturbed, any work that is governed by these monuments shall be held in abeyance until the monuments are reestablished by the Contractor. The accuracy of all the Contractor's stakes, alignments, and grades is the responsibility of the Contractor. However, the Engineer has the discretionary right to check the Contractor's stakes, alignments, and grades at any time. Where such discretion is to be exercised by the Engineer, he will notify the Contractor of his intention, stating the time at which the checking will commence. Any part of the work in progress, the results of which are predicated directly upon the Contractor's stakes, alignments, or grades to be checked, shall be held in abeyance until the Engineer has notified the Contractor that the checking has been completed.

010037 PARTIAL ACCEPTANCE OF WORK

After completion of certain portions of the Work, including all testing and other preparation necessary for operation of such portions by the Owner as herein specified, but prior to final completion of the Work, provisions may be made for partial acceptance in writing by the Owner for such portions only. The portions of the Work to be included for partial acceptance prior to final project completion will be noted at the preconstruction conference in accordance with Contractor's schedule, or by written notice to the Contractor at the earliest possible time.

The guarantee period for such portions of the Work shall commence with the date of their acceptance for use by the Owner. However, full payment for such portions will not be made until final acceptance of the total Work.

Acceptance of any portion of the Work prior to acceptance of the whole shall not be construed as absolving the Contractor of responsibility for any item of construction or incidental work included in the Contract.

Prior to such occupancy or use the Owner will enter into a written agreement with the Contractor delineating the portions of the Work released to the Owner for occupancy or use and indicating what, if any, work remains to be done within the occupied or released area. If such prior use increases the cost of or delays the Work, the Contractor shall be entitled to such extra compensation, or extension of time, or both, as may be determined by the Owner after consideration of recommendations by the Engineer.

Should any portion of the Work in use be damaged thereby, the Owner shall bear the expense for repairing such damage. However, if the portion being so used should reveal deficiencies of materials or workmanship, it shall be the Contractor's responsibility to replace the defective construction.

010060 REGULATORY REQUIREMENTS

010061 UTAH COUNTY

All work performed under this contract shall conform to the permits issued by Utah County.

010062 WATER QUALITY

All work performed under this contract shall conform to the Utah State Division of Drinking Water Standards.

010090 DEFINITIONS AND ABBREVIATIONS

010091 DEFINITIONS AND TERMS

Whenever in these Specifications, or in other Contract Documents, the following terms are used, the intent and meaning shall be interpreted as follows:

CALENDAR DAY: Every day shown on the calendar.

CONTRACT TIME: The number of calendar days for completion of the Work, including authorized time extensions. In case a calendar date of completion is specified in the proposal in lieu of the number of calendar days, the Work shall be completed by that date. The Contract Time shall be computed by excluding the first and including the last day; and if the last day be Sunday or a legal holiday, that shall be excluded.

DESIGN ENGINEER: Epic Engineering, 3341 South 4000 West, West Valley City, Utah, 84120 (801) 955-5605

ENGINEER: Epic Engineering, 3341 South 4000 West, West Valley City, Utah, 84120 (801) 955-5605

EQUIPMENT: (Construction) - All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and also tools and apparatus necessary for the proper construction and acceptable completion of work. (Installed) - All material or articles used in equipping a facility as furnishings or apparatus to fulfill a functional design.

EXTRA WORK: An item of work not provided for in the Contract as awarded but found essential to the satisfactory completion of the Contract within its intended scope.

LABORATORY: The established materials testing laboratory of the Contracting Agency's Engineering Department, or other laboratories acceptable to or authorized by the Engineer to test materials and work involved in the Contract.

NOTICE OF AWARD: A letter from the Owner advising a bidder that his Proposal has been accepted.

OWNER: Orem City, 56 N State Street, Orem UT 84057

PROJECT REPRESENTATIVE: The Engineer's authorized representative at the site of the Work.

PROPOSAL: The offer of a bidder, on the prescribed form, to perform the Work.

PROPOSAL FORM: The approved form on which the Owner requires bids to be prepared and submitted for the Work.

PROPOSAL GUARANTEE: The security furnished with a bid to guarantee that the bidder will enter into the Contract if his bid is accepted.

REFERENCED DOCUMENTS: Bulletins, Standards, Rules, Methods of Analysis or Test, Codes and Specifications of public or private agencies, Engineering Societies, or Industrial Associations. Reference shall be to the latest edition thereof, including Amendments, which are in effect and published at the time the Notice Inviting Bids is issued, unless a specific edition is identified, in which case reference shall be to such specific edition.

SHOP DRAWINGS: Drawings or reproduction of drawings, detailing, fabrication and erection of structural elements, falsework and forming for structures, fabrication of reinforcing steel, installed equipment and installation of systems, or any other supplementary plans or similar data.

SUPERINTENDENT: The Contractor's authorized representative in responsible charge of the Work.

TITLE AND HEADINGS: The titles or headings of the section and subsections in the Contract Documents are intended for convenience of reference and shall not be considered as having bearing on their interpretation.

WORKING DAY: A calendar day, exclusive of Saturdays, Sundays, and Owner's recognized legal holidays, on which weather and other conditions not under the control of the Contractor will permit construction operations to proceed for the major part of the day with the normal working force engaged in performing the controlling item or items of work which would be in progress at that time.

010092 ABBREVIATIONS

AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials (formerly AASHO)
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturers' Association, Inc.
AGMA	American Gear Manufacturers' Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
AWS	American Welding Society
AWWA	American Water Works Association
CRSI	Concrete Reinforcing Steel Institute
FS	Federal Specification
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
NFPA	National Fire Protection Association
OSHGS	On-site Sodium Hypochlorite Generation System
PS	Product Standard
SAE	Society of Automotive Engineers
SSPC	Steel Structures Painting Council
UL	Underwriters' Laboratories, Inc.

010200 PROJECT MEETINGS

010210 PRECONSTRUCTION CONFERENCE

Upon receipt of the Notice to Proceed, or at an earlier time if mutually agreeable, the Engineer will arrange a preconstruction conference to be attended by the Contractor's superintendent, the Owner, the Engineer or his representative, the Division of Drinking Water and representatives of utilities, major subcontractors, and others involved in the execution of the Work.

The purpose of this conference shall be to establish a working understanding between the parties and to discuss the Construction Schedule, shop drawing submittals and processing, cost breakdown of major lump sum items, applications for payment and their processing, and such other subjects as may be pertinent for the execution of the Work.

010220 PROGRESS MEETINGS

The Contractor shall arrange and conduct progress meetings. These meetings shall be conducted once every week but not less than once every month and shall be attended by the Contractor's superintendent and representatives of all subcontractors, utilities, and others, who are active in the execution of the Work. The purpose of these meetings shall be to expedite the work of any subcontractor or other organization that is not up to schedule, resolve conflicts, and in general, coordinate and expedite the execution of the Work.

The agenda of progress meetings shall include review of progress and schedule, of payment request, of narrative report, of the latest Construction Schedule update, and of the record documents.

010221 PROGRESS AND SCHEDULE REVIEW

The progress of the Work and the Construction Schedule shall be reviewed to verify:

- A. Actual start and finish dates of completed activities since the last progress meeting.
- B. Durations and progress of all activities not completed.
- C. Reason, time, and cost data for Change Order work that is to be incorporated into the Construction Schedule or payment request form.
- D. Payment due to the Contractor based on percentage complete of items in the submitted payment request form.
- E. Reason and duration of required revisions.

010222 REVIEW OF PAYMENT REQUEST

The Contractor shall have his copy of the payment request form and all other data required by the Contract Documents filled in and completed prior to the progress meeting. The Engineer will process Contractor's payment request after satisfactory review of the narrative report and schedule update.

010224 REVIEW OF NARRATIVE REPORT

The Contractor shall submit a narrative report at the progress meeting as a part of the progress review and update, in a form agreed upon by the Contractor and the Engineer. The narrative report shall include a description of problem areas; current and anticipated delaying factors and their estimated impact on performance of other activities and completion dates; and an explanation of corrective action taken or proposed.

010226 REVIEW OF SCHEDULE UPDATE

After each monthly update, the Contractor shall submit to the Engineer one print of the last accepted Construction Schedule, marked up in red in accordance with the monthly review meeting; and one sepia, and three blueline copies incorporating the updated schedule information.

010300 SUBMITTALS

In ample time for each to serve its purpose and function, the Contractor shall submit to the Engineer such schedules, reports, drawings, lists, literature samples, instructions, directions, and guarantees as are specified or reasonably required for construction, operation, and maintenance of the Work.

010310 CONSTRUCTION SCHEDULE AND SCHEDULE OF VALUES

010311 POST-BID PRE-AWARD SCHEDULE

As a condition of award during the period after the opening of bids and prior to actual award of the Contract by the Owner, the apparent low bidder shall prepare a detailed cost-loaded Construction Schedule as set forth in this section. The costs shall be developed from the Schedule of Values submitted concurrently with this post-bid pre-award submittal. This schedule shall essentially be the same as the final project Construction Schedule required to be submitted and maintained for this project. The Construction Schedule shall indicate the time of starting and completion of each major structure or phase of the Work and such intermediate phases as will serve for well-defined control points. These phases and control points shall be placed in chronological order on the Construction Schedule. The schedule shall also indicate the anticipated date of receipt of major items of equipment, and all items of equipment receipt and installation of which is critical to the scheduled progress of the project.

Within five (5) calendar days after bid date, the apparent low bidder shall designate in writing, an authorized representative in its firm who will be responsible for the preparation of the post-bid pre-award Construction Schedule as set forth in this Section.

The apparent low bidder's representative shall have the authority to act on behalf of the Contractor in fulfilling the requirements of preparing the schedule in a professional and acceptable manner demonstrating competence in use of the Construction Schedule, including scheduling experience on projects of similar value and complexity.

After fulfilling requirements above, the apparent low bidder's representative, in a coordinated effort with the Engineer, shall complete the preparation of the schedule within 15 calendar days after the 5-day period noted above. The schedule shall include costs allocations for all the component activities which make up a phase of work. All the identifiable work items in the lump sum breakdown of proposal, as listed on the Breakdown of Lump Sum Items of Work, shall be included in this schedule and the sum of allocations shall equal the total of the lump sum bid proposal submitted by the apparent low bidder.

010312 POST-AWARD SCHEDULE

Within five days of award of Contract by the Owner, the Engineer will return the post-bid pre-award Construction Schedule to the Contractor. The Contractor shall modify the schedule to include any modifications, or changes resulting from alternates selected by the Owner and final phasing and scheduling of work items or control points.

The Contractor shall complete these modifications within five calendar days from date the schedule is returned to him and shall resubmit it for review. Upon receiving written notice from the Engineer that the schedule, as revised, has been accepted, it will then become the initial Construction Schedule by which the Contractor shall construct the Work and shall be subject to progress reporting, revision, and updating procedures implemented during the course of construction as specified elsewhere in this DIVISION 1.

The initial Construction Schedule shall contain no contract changes or delays which may have occurred during the interim submittal period. Changes shall be entered at the first update revision as specified hereinafter under Revisions to Construction Schedule.

If the Contractor's progress has fallen behind the accepted Construction Schedule, the Contractor shall take such steps as may be required, including but not limited to, increasing the number of personnel, shifts, overtime operations, days of work, and amount of construction equipment until such time as the Work is back on schedule. He shall also submit at the next progress meeting such supplementary schedule or schedules as may be deemed necessary to demonstrate the manner in which the approved rate of progress will be regained.

010313 WEEKLY ACTIVITIES PLAN

On the last working day of every week Contractor shall submit to Engineer Contractor's Plan of Activities for the following two weeks. The Plan of Activities shall describe the activity and location of the activity.

010314 REVISIONS TO CONSTRUCTION SCHEDULE

The Contractor shall submit a revised Construction Schedule within five days of the occurrence of any of the following:

- A. When delay in completion of any activity or group of activities indicates an overrun of the Contract time or control point requirement, by 30 working days or ten percent (10 percent) of the remaining duration, whichever is less.
- B. Delays in submittals, deliveries, or work stoppage are encountered which make replanning or rescheduling of the work necessary.
- C. The schedule does not represent the actual prosecution and progress of the project as being performed in the field.

Acceptance of the revised Construction Schedule and all supporting data is contingent upon compliance with other related requirements specified before in this DIVISION 1 and any other previous agreements or requirements with or by the Engineer.

The cost of revisions to the Construction Schedule resulting from Contract changes will be included in the cost for the change in the Work and will be based on the complexity of the revision or Change Order, man-hours expended in analyzing the change, and the total cost of the change.

The cost of revision to the Construction Schedule not resulting from authorized changes in the Work shall be the responsibility of the Contractor.

010315 SCHEDULE OF VALUES

In conjunction with the submittal of the post-bid, pre-award Construction Schedule, the apparent low bidder shall submit a schedule of values of the work, including quantities and unit prices. The aggregate of these extended prices shall equal the Lump Sum Contract Price. This schedule shall be satisfactory in form and substance to the Engineer and shall subdivide the work into the specified component parts. Upon approval by the Engineer the schedule shall be incorporated into the form for Application for Payment and shall become the basis for preparing monthly pay estimates.

Where so specified, a structure, system, or facility shall be broken down into components of work related to the Divisions of the Specifications. The cost for work specified in each Division shall be listed and the sum of the Division costs shall represent the total cost for such structure, system, or facility.

A. Mobilization.

1. The amounts included under this item shall be limited to the amounts which meet the following simultaneous conditions:
 - a. The amounts represent only costs directly related to the Work incurred for the sub-items listed under Mobilization in the Schedule of Values.
 - b. The amounts represent costs borne directly by the Contractor and shall not include costs incurred by subcontractors.
 - c. The amounts are found reasonable and acceptable by the Engineer.
2. The Contractor shall furnish data and documentation to substantiate the amounts claimed under the item Mobilization.
3. Payment of mobilization items will be made in direct proportion to the execution of the first 10 percent of the Work.
 - a. Such 10 percent of the Work shall be computed on the basis of acceptable work performed and acceptable materials and equipment suitably stored at the site as specified in the Contract Documents and shall not include work under mobilization nor work performed and materials and equipment furnished for temporary purposes such as Contractor's plant and equipment, forms, and temporary fences.
 - b. No payments will be made for amounts not justified with supporting documentation satisfactory to the Engineer.

(Non-inclusive Sample Only)
SCHEDULE OF VALUES

<u>Item</u>	<u>Description of Item</u>	<u>Lump Sum Cost</u>
1.	Mobilization/Demobilization	
	a. Specified bonds and insurance	_____
	b. Contractor's office at the site of the Work	_____
	c. Field office for Contractor	_____
	d. Permits, licenses, and fees directly related to and necessary for the performance of the Work	_____
	e. Jersey barrier placement (site protection)	_____
	TOTAL FOR THIS ITEM	_____
2.	Sitework	
	a. General earthwork and grading	_____
	b. Dewatering	_____
	c. Asphalt	_____
	d. Imported fill	_____
	e. Fencing	_____
	f. Concrete Sidewalk	_____
	TOTAL FOR THIS ITEM	_____
3.	Yard Piping	
	a. Division 2 items (list out separately)	_____
	b. Division 3 items (list out separately)	_____
	c. Division 15 items (list out separately)	_____
	TOTAL FOR THIS ITEM	_____
4.	Pump Station	
	a. Division 2 items (list out separately)	_____
	b. Division 3 items (list out separately)	_____
	c. Division 4 items (list out separately)	_____
	d. Division 5 items (list out separately)	_____
	e. Division 6 items (list out separately)	_____
	f. Division 7 items (list out separately)	_____
	g. Division 8 items (list out separately)	_____
	h. Division 9 items (list out separately)	_____
	i. Division 10 items (list out separately)	_____
	k. Division 12 items (list out separately)	_____
	l. Division 13 items (list out separately)	_____
	m. Division 14 items (list out separately)	_____
	n. Division 15 items (list out separately)	_____
	o. Division 16 items (list out separately)	_____
	TOTAL FOR THIS ITEM	_____

5.	General Electrical (not included above)	
	TOTAL FOR THIS ITEM	=====
6.	General Instrumentation (not included above)	
	TOTAL FOR THIS ITEM	=====
7.	Miscellaneous Work Items and All Other Costs Not Included in Previous Items and Necessary to Complete the Work	
	a. O & M Manuals	=====
	b. As-built Drawings	=====
	TOTAL FOR THIS ITEM	=====
TOTAL FOR ALL ITEMS (CONTRACT AMOUNT)		

010320 SHOP DRAWINGS, SCHEDULES, AND SAMPLES

Shop drawings, layout diagrams, catalog data, test reports, and information in sufficient detail to show complete compliance with all specified requirements shall be furnished to the Engineer covering but not limited to the items under Materials and Equipment List.

The Contractor, at his own expense, shall make such changes in the required drawings as may be necessary to conform to the Contract Documents. After completion of such checking, verification, and revising, the Contractor shall stamp and sign the drawings indicating his approval and submit the shop drawings and pertinent data to the Engineer for review. Prior to the Engineer's review of such drawings, any work which the Contractor may do on the fabrications covered by the same shall be at his own risk, as the Owner will not be responsible for any expense or delays incurred by the Contractor for changes to make the same conform to the Contract Documents.

010321 MATERIALS AND EQUIPMENT LIST -- (Non-inclusive Listing)

Access Hatches, Architectural Finishes	Plumbing Fixtures
Backfill Materials	Pressure Gauges
Caulking	Pressure Relief Valve
Check Valves	Pumps
Concrete Mixes	Pumps and Controls
Concrete Fabricated Wall	Pump Cans
Control Valves	Pump Discharge Head
Crushed Rock	Rebar & Rebar Shop Drawings
Drains	Roofing Materials
Electrical Fixtures and Appliances	Roof Trusses
Electrical Load Centers, MCC	Screen
Electrical Substations, Transformers and	Sealants
Electric Conduit, Wire and Specials	Signs

Engineered Fill	Sleeves
Fabricated Metals	Sky Lights
First Aid Kit	Sound Board
Grating	Strainer
Hardware	Structural Steel
Imported Fill	Stucco & Rock
Instrumentation	Switch Gear
Insulation	Tanks
Meters and Meter Panels	UBC
Motors, Starter, and Controls	Valves
Masonry Block	Valve Operators and Controllers
Paints, Coatings and Sealants	Ventilation Equipment
Pipe, Fittings, and Specials	Waterstop
Pipe Supports and Anchors	Water Proofing

010322 SUBMITTAL

Note: As an effort to ensure project scheduling and completion, payment to the Contractor for work completed will not be paid beyond 10% of the contract bid amount until all submittals (listed in 010321) for materials and equipment have been submitted to the Engineer for review. Release of payments above the 10% amount will not be contingent upon the Engineer's review of the submittals, nor the return and resubmittal of a reject submittal.

Shop drawings and data (electronic or 3 hard copies) shall be submitted to the Engineer. The submittal shall clearly indicate the specific area of the Contract Documents for which the submittal is made. Two copies received by him will be returned to the Contractor's representative at the jobsite. The Engineer's notations of the action which he has taken will be noted on these returned copies.

Each submittal shall be provided with the following:

1. A signature by the Contractor indicating he has reviewed the submittal.
2. The specification section number regarding the submittal.
3. A list of "ALL" deviations from the specifications and the reasons for the deviation.
4. The local suppliers or distributors and their names, phone numbers and contact people.
5. Each specification item submittal shall be given a successive submittal number.

The above drawings, lists, prints, samples, and other data shall become a part of the Contract Documents, and a copy of the same shall be kept with the jobsite Contract Documents, and the fabrications furnished shall be in conformance with the same. However, the Engineer's review of the above drawings, lists, prints, specifications, samples, or other data shall in no way release the Contractor from his responsibility for the proper fulfillment of the requirements of this Contract nor for fulfilling the purpose of the installation nor from his liability to replace the same, should it prove defective or fail to meet the specified requirements.

010323 MATERIAL AND EQUIPMENT SCHEDULES

Drawings of minor or incidental fabricated materials and equipment may not be required by the Engineer. The Contractor shall furnish the Engineer tabulated lists of such fabrications and equipment, showing the names of the manufacturers and catalog numbers, together with samples or general data as may be required to permit determination as to their acceptability for incorporation in the Work.

010324 CRITICAL EQUIPMENT SUBMITTALS

The Contractor shall make Submittals to the Engineer in a timely manner for the work to be completed within the specified Contract Time.

For the following equipment items, inquiry reveals that potentially long lead times for delivery are required, making these items critical for completion of the Work within the Contract Time.

1. Pumps
2. Flow meter
3. Pressure relief/ surge anticipator valve
4. Motor control center
5. Flow Control Valve
6. Standby Generator

The preceding list does not necessarily include all critical equipment items. The Contractor shall be responsible for identification and timely Submittal of all equipment items. The Engineer will endeavor to expedite Submittal review of the critical equipment items to aid in reducing Submittal processing time.

010325 MILL TESTS

The Contractor, at his own expense, shall submit, in triplicate, certified copies of all required factory and mill test reports to verify material quality and composition. Any materials shipped by the Contractor from a factory or mill prior to having satisfactorily passed testing and inspection shall not be incorporated in the Work, unless the Engineer shall have notified the Contractor in writing that such testing and inspection will not be required. The cost of performing all mill and factory tests shall be paid by the Contractor unless otherwise provided in the Contract Documents.

010326 REINFORCING STEEL

Shop drawings on reinforcing steel detailed by the Contractor in accordance with the Contract Documents will not be reviewed and returned. The Contractor shall supply the Engineer with a copy of all reinforcing steel detail drawings. Changes to the Contract Documents made by the Contractor in reinforcing steel shop drawings shall be called out in the letter of submittal. Such changes will not be acceptable unless the Engineer has expressed consent to such changes in writing.

010340 TUNNELS, JACKING, AND BORING

The Contractor shall submit to the Engineer in advance of tunneling or jacking a detailed description of the process to be used. This detailed description shall include the equipment to be used; detailed schedule for the work; safety precautions to be taken showing compliance and any other codes or agencies having jurisdiction; monitoring of railroad track movement; contingency plan for correcting track movement; and any other pertinent information on items of work required to perform the work.

010400 QUALITY CONTROL

All materials and equipment shall be new and of the specified quality and equal to the samples found to be acceptable by the Engineer, if samples have been submitted. The Work shall be done and completed in a thorough, workmanlike manner, notwithstanding any omission in the Contract Documents; and it shall be the duty of the Contractor to call the Engineer's attention to apparent errors or omissions and request instructions before proceeding with the Work. The Engineer may, by appropriate instructions, correct errors and supply omissions, which instructions shall be as binding upon the Contractor as though contained in the original Contract Documents.

At the option of the Engineer, materials and equipment to be supplied under this Contract will be tested and inspected either at their place of origin or at the site of the Work. The Contractor shall give the Engineer written notification well in advance of actual readiness of materials and equipment to be tested and inspected at point of origin. Satisfactory tests and inspections at the point of origin shall not be construed as a final acceptance of the materials and equipment nor shall such tests and inspections preclude retesting or re-inspection at the site of the Work.

Materials and equipment which will require testing and inspection at the place of origin shall not be shipped prior to such testing and inspection.

010410 AUTHORITY AND DUTIES OF OWNER'S REPRESENTATIVE (INSPECTOR)

Owner's Representative (Inspector) employed by the Owner or Engineer shall be authorized to inspect all work done and materials and equipment furnished. Such inspection may extend to all or any part of the Work, and to the preparation, fabrication, or manufacture of the materials and equipment for the Work. The Inspector will not alter or waive the provisions of the Contract Documents.

The Inspector will keep the Engineer informed as to the progress of the Work being done. Such deficiencies or defects in Work which may have been observed will be called to the Contractor's attention. The Inspector will not inspect Contractor's means, methods, techniques, sequences, or procedures for construction. The Inspector will not approve or accept any portion of the Work, issue instructions contrary to the intent of the Contract Documents, or act as foreman for the Contractor. The Inspector will conduct on-site observations of the Work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents. The Inspector will report to Engineer whenever Inspector believes the Work is faulty, defective, does not conform to the Contract Documents, or has been damaged; or whenever there is defective material or equipment; or whenever the Inspector believes the Work should be uncovered for observation or the Work requires special testing. In no event will the Inspector supervise, control, or direct the Contractor's safety precautions or programs; or inspect for safety conditions on the site, or of persons thereon, whether Contractor's employees or others.

010411 INSPECTION

Materials, equipment, and workmanship shall be subject to the inspection of, and rejection by, the Engineer, if not in conformance with the Contract Documents. Defective materials, equipment, or work shall be removed from the premises by the Contractor, whether in place or not, and shall be replaced with new and acceptable materials, equipment, or work. Repair of defective materials, equipment, or work shall be subject to the Engineer's acceptance.

On all questions concerning the acceptability of materials or equipment, classification of materials or equipment, execution of the Work, and the determination of costs, the decision of the Engineer shall be final and binding upon all parties.

The Contractor shall at all times maintain proper facilities and provide safe access to all parts of the Work, to the shops wherein the Work is in preparation, and to all warehouses and storage yards wherein materials and equipment are stored, for purposes of inspection by the Engineer. Should any Work be covered up before the Engineer has had the opportunity to observe such Work, it shall, if required by the Engineer, be uncovered for examination at the Contractor's expense.

010420 SAMPLES AND TESTS

At the option of the Engineer, the source of supply of materials for the Work shall be subject to tests and inspection before the delivery is started and before such materials are used in the Work. Representative preliminary samples of the character and quality prescribed shall be submitted by the Contractor or producer of materials to be used in the Work in sufficient quantities or amounts for testing or examination.

All tests of materials furnished by the Contractor shall be made in accordance with the commonly recognized standards of national technical organizations, and such special methods and tests as are prescribed in the Contract Documents.

010421 SAMPLING

The Contractor shall furnish such samples of materials as are requested by the Engineer, without charge. No material shall be used until the Engineer has had the opportunity to test or examine such materials. Samples will be secured and tested whenever necessary to determine the quality of the material. Samples and test specimens prepared at the jobsite, such as concrete test cylinders, shall be taken or prepared by the Engineer in the presence and with the assistance of the Contractor.

010422 TESTING

Except for specified mill tests, soil compaction tests, concrete tests, and other specified tests, routine tests of materials will be at the expense of the Owner and will be performed in a laboratory selected by Owner.

In the event the Contractor protests a failing test of material in place or to be used, he shall take additional samples as herein specified and have additional tests run at his own expense. In the event the original test proves to have been in error, the Contractor shall be reimbursed for his direct costs of sampling and testing.

010423 TEST STANDARDS

All sampling, specimen preparation, and testing of materials shall be in accordance with the standards of nationally recognized technical organizations.

The physical characteristics of all materials not particularly specified shall conform to the latest standards published by the American Society for Testing Materials, where applicable.

010430 EQUIPMENT TESTS

All items of mechanical equipment shall be tested for proper operation, efficiency, and capacity.

010431 FACTORY TESTS

All major items of equipment so specified shall be test run at the point of manufacture at the Contractor's expense, and not less than three certified copies of the test results delivered to the Engineer. Such equipment shall not be shipped until the Engineer has reviewed the test results and notified the Contractor in writing that the equipment may be shipped. Such notice, however, shall not be considered as final acceptance, which will only be made on the basis of the results of tests of the equipment after it is installed.

010432 PRELIMINARY EQUIPMENT TESTS

All items of mechanical equipment shall be tested by the Contractor after installation for proper operation, efficiency, and capacity. The Contractor's test operation of each piece of mechanical equipment shall continue for not less than eight hours without interruption. All parts shall operate satisfactorily in all respects, under continuous full load, and in accordance with the specified requirements, for the full duration of the 8-hour test period. If any part of a unit shows evidence of unsatisfactory or improper operation during the 8-hour test period, correction or repairs shall be made and the full 8-hour test operation, as specified above, shall be repeated after all parts operate satisfactorily. The Contractor shall furnish all personnel, power, water, chemicals, fuel, oil, grease, and all other necessary facilities for conducting the Contractor's test operations.

010433 FINAL TEST OPERATION

After all equipment is installed and the entire plant is ready to operate, the Owner will test all equipment for a period not to exceed seven days by operating either under actual or simulated operating conditions before final acceptance is given. All defects of material or workmanship which appear during this test period shall be corrected by the Contractor. After such corrections are made, the seven-day test shall be run again before final acceptance.

The Owner will supply power, water, oil, grease, auxiliaries, and operating personnel required for the final test operation.

On certain items of equipment, the final adjustments and inspections shall be made by factory-trained service personnel other than sales representatives, who shall also supervise the test operation. This requirement shall be fulfilled when so specified in the Specifications covering such equipment. Manufacturers who furnish equipment in connection with which the presence of factory-trained service personnel is specified shall supply, at no additional cost to the Owner, factory-trained service personnel as described above to adjust such equipment until it has been tested by the Contractor and the results of these tests have been satisfactory.

010500 TEMPORARY FACILITIES

The Contractor shall provide all temporary facilities and utilities required for completion of the Work as well as safety precautions and programs. Section 010500 through 010599 are areas of concern to the Owner and are representative of the temporary facilities, utilities, and activities which are solely the Contractor's responsibility. No attempt is made to set out in detail the Contractor's means or methods necessary to accomplish the tasks involved. Recognition of these temporary facilities and activities is provided only to allow the Contractor to identify necessary additional costs in planning the Work.

010510 TEMPORARY OFFICES

010511 PROJECT OFFICE

The Contractor shall maintain on the project site a suitable office or other protected area in which shall be kept project copies of the Contract Documents, project progress records, project schedule, shop drawings, and other relevant documents which shall be accessible to the Owner and Engineer during normal working hours.

In addition to the field office, the Superintendent shall maintain a personally assigned portable cellular phone at the site at all times when work is in process. Rental of the phone shall be paid for by the Contractor.

The field office shall be completed within two weeks after the Contractor starts the site work, in a location acceptable to the Engineer. The building and furnishings shall be removed at the conclusion of the Work, or at any time during construction as directed by the Engineer, and shall remain the property of the Contractor.

010520 TEMPORARY UTILITIES

010521 ELECTRICAL SERVICE

Electrical service is currently available at the project site. The Contractor shall be responsible for coordinating access to power with the Owner.

010522 WATER

The Contractor shall pay for and shall construct all facilities necessary to furnish water for his use during construction. Water used for human consumption shall be kept free from contamination and shall conform to the requirements of the State and local authorities for potable water. The Contractor shall pay for all water used for the Contractor's operations prior to final acceptance except that the Owner will provide water for one pressure/leak test operation and one sterilization operation.

010525 TEMPORARY LIGHTING

The Contractor shall provide temporary lighting in all work areas sufficient to maintain a lighting level during working hours not less than the lighting level required by Utah OSHA standards. As permanent lighting facilities are completed, they may be used in lieu of temporary facilities, provided however, that bulbs, lamps, or tubes of such facilities used by the Contractor shall be replaced prior to final acceptance of the Work.

010526 HEATING AND VENTILATION

The Contractor shall provide means for heating and ventilating all work areas as may be required to protect the Work from damage by freezing, high temperatures, weather, or to provide a safe environment for workers. Unvented direct fired heaters shall not be used in areas where freshly placed concrete will be exposed to combustion gases until at least two hours after the concrete has attained its initial set.

010527 SANITARY CONVENIENCES

The Contractor shall provide suitable and adequate sanitary conveniences for the use of all persons at the site of the Work. Such conveniences shall include chemical toilets or water closets and shall be located at appropriate locations at the site of the Work. All sanitary conveniences shall conform to the regulations of the public authority having jurisdiction over such matters. At the completion of the Work, all such sanitary conveniences shall be removed and the site left in a sanitary condition.

With respect to sanitation facilities, if the Work is Federally funded the Contractor shall cooperate with and follow the directions of representatives of the Public Health Service and the State. State and County Public Health Service representatives shall have access to the Work, whether it is in preparation or progress, and the Contractor shall provide facilities for such access and inspection.

010528 ACCIDENT PREVENTION

Precaution shall be exercised by the Contractor at all times for the protection of persons (including employees) and property. The safety provisions of applicable laws, and of building and construction codes shall be observed. Machinery, equipment, and other hazards shall be guarded or eliminated.

First aid facilities and information posters conforming at least to the minimum requirements of the Occupational Safety and Health Administration shall be provided in a readily accessible location or locations.

The Contractor shall make all reports as are, or may be, required by any authority having jurisdiction, and permit all safety inspections of the work being performed under this Contract. Before proceeding with any construction work, the Contractor shall take the necessary action to comply with all provisions for safety and accident prevention.

010530 CONSTRUCTION FACILITIES

Construction hoists, elevators, scaffolds, stages, shoring, and similar temporary facilities shall be of ample size and capacity to adequately support and move the loads to which they will be subjected. Railings, enclosures, safety devices, and controls required by law or for adequate protection of life and property shall be provided.

010533 STAGING AND SHORING

Temporary supports shall be designed with an adequate safety factor to assure adequate load bearing capability. If requested by the Engineer, the Contractor shall submit design calculations by a professional registered engineer for staging and shoring prior to application of loads.

010534 BARRICADES

Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations from one hour before sunset

each day to one hour after sunrise of the next day until such excavation is entirely refilled, compacted, and paved. All excavations shall be barricaded in such a manner as to prevent persons from falling, walking, or otherwise entering any excavation in any street, roadway, parking lot, treatment plant, or any other area, public or private.

010540 WARNING DEVICES AND BARRICADES

The Contractor shall adequately identify and guard all hazardous areas and conditions by visual warning devices and, where necessary, physical barriers. Such devices shall, as a minimum, conform to the requirements of Utah/OSHA.

010541 HAZARDS IN PUBLIC RIGHT-OF-WAY

Trenches and other essentially continuous excavations in the public right-of-way, running parallel to the general flow of traffic, shall be marked at reasonable intervals by traffic cones, barricades, or other suitable visual markers during daylight hours. During hours of darkness these markers shall be provided with torches, flashers, or other adequate lights.

At intersections or for pits and similar excavations, where traffic may reasonably be expected to approach head on, such excavations shall be protected by essentially continuous barricades lighted at close intervals during hours of darkness.

010542 HAZARDS IN PROTECTED AREAS

Excavations on project sites from which the public is excluded shall be marked or guarded in a manner appropriate for the hazard.

010543 ABOVE GRADE PROTECTION

On multi-level structures the Contractor shall provide safety protection that, as a minimum, shall meet the requirements of the Utah Department of Industrial Relations Safety Orders.

010544 PROTECTION OF EXISTING ITEMS

The Contractor shall protect all existing structures, trees, shrubs, and other items on the project site that are to be preserved, by substantial barricades or other devices commensurate with the hazard, from injury or destruction by vehicles, equipment, workmen, or other agents.

010550 PROJECT SECURITY

The Contractor shall make adequate provision for the protection of the Work area against fire, theft, and vandalism, and for the protection of the public against exposure to injury.

010551 FIRST AID

First aid facilities and information posters conforming to requirements of OSHA and other applicable Laws and Regulations shall be provided in readily accessible locations.

010552 FIRE EXTINGUISHERS

Sufficient number of fire extinguishers of the type and capacity required to protect the Work and ancillary facilities, shall be provided in readily accessible locations.

010555 TEMPORARY FENCES

Except as otherwise provided, the Contractor shall enclose the site of the Work with a fence adequate to protect the Work and temporary facilities against acts of theft, violence, or vandalism.

In the event all or a part of the site is to be permanently fenced, this permanent fence or a portion thereof may be built to serve for protection of the Work site, provided however that any portions damaged or defaced shall be replaced prior to final acceptance.

Temporary openings in existing fences shall be protected to prevent intrusion by unauthorized persons during night hours, weekends, holidays, and other times when no work is performed at the site. The Contractor shall provide temporary closures or guard service to protect such openings. Temporary openings shall be fenced when no longer necessary.

010560 ACCESS ROADS

The Contractor shall build and maintain adequate access roads to and on the site of the Work to provide for delivery of material and for access to existing and operating plant facilities on the site. A road to be considered adequately maintained shall be reasonably dust free.

010561 OFF-SITE ROADS

Except as otherwise indicated or specified, off-site access roads shall be adequately maintained graded earth roads. Such roads shall be built only in the public right-of-way or easements obtained by the Owner. If the Contractor elects to build along some other alignment he shall obtain the necessary rights-of-way or easements.

010563 ON-SITE ACCESS ROADS

Adequately maintained access roads shall be maintained to all storage areas and other areas to which frequent access is required. Similar roads shall be maintained to all existing facilities on the site of the Work to provide access for maintenance and operation. Where such temporary roads cross buried utilities that might be injured by the loads likely to be imposed, such utilities shall be adequately protected by steel plates or wood planking, or bridges shall be provided so that no loads shall discharge on such buried utilities.

010570 SPECIAL CONTROLS

The Contractor shall take all reasonable means to minimize inconvenience and injury to the public by dust, noise, diversion of storm water, or other agencies under his control.

010571 DUST CONTROL

The Contractor shall take whatever steps, procedures, or means as are required to prevent abnormal dust conditions being caused by his operations in connection with the execution of the Work; and on any unpaved road which the Contractor or any of his subcontractors are using, excavation or fill areas, demolition operations, or other activities. Control shall be by sprinkling, use of dust palliatives, modification of operations, or any other means acceptable to agencies having jurisdiction.

010573 NOISE ABATEMENT

In inhabited areas, particularly residential, operations shall be performed in a manner to minimize unnecessary noise generation. In residential areas, special measures shall be taken to suppress noise generated by repair and service activities during the night hours.

010575 DRAINAGE CONTROL

In excavation, fill, and grading operations care shall be taken to disturb the pre-existing drainage pattern as little as possible. Particular care shall be taken not to direct drainage water onto private property or into streets or drainage-ways inadequate for the increase flow. Drainage means shall be provided to protect the Work.

010700 PROJECT CLOSEOUT

It is the intent of these Contract Documents that the Contractor shall deliver a complete and operable facility capable of performing its intended functions and ready for use.

010710 CLEANING

Throughout the period of construction, the Contractor shall keep the Work site free and clean of all rubbish and debris, and shall promptly remove from the site, or from property adjacent to the site of the Work, all unused and rejected materials, surplus earth, concrete, plaster, and debris, excepting select material which may be required for refilling or grading.

010711 FINAL SITE CLEAN-UP

Upon completion of the Work, and prior to final acceptance, the Contractor shall remove from the vicinity of the Work, surplus material, and equipment belonging to him or used under his direction during construction.

010712 FINAL BUILDING CLEAN-UP

On all building projects and wherever else applicable, besides general broom cleaning, the following special cleaning shall be performed at completion of the Work:

- A. Putty stains and paint shall be removed from glass; glass shall be washed and polished, inside and outside. Care shall be exercised so as not to scratch glass.
- B. Marks, stains, fingerprints, and other soil and dirt shall be removed from painted, decorated, or stained work.
- C. Waxed woodwork shall be cleaned and polished.
- D. Hardware shall be cleaned and polished of all traces; this shall include removal of stains, dust, dirt, paints, and blemishes.
- E. Spots, soil, paint, plaster, and concrete shall be removed from tile; tile work shall be washed afterwards.

- F. Fixtures and equipment shall be cleaned and stains, paint, dirt, and dust shall be removed.
- G. Temporary floor protections shall be removed; floors shall be cleaned, waxed, and buffed.
- H. Dust, cobwebs, and traces of insects and dirt shall be removed.

010715 WASTE DISPOSAL

The Contractor shall dispose of surplus materials, waste products, and debris and shall make necessary arrangements for such disposal. The Contractor shall obtain written permission from property owner prior to disposing surplus materials, waste products, or debris on private property.

Ditches, washes, or drainage-ways shall not be filled if this action may create water control problems.

Disposal operations shall not create unsightly or unsanitary nuisances.

The Contractor shall maintain the disposal site in a condition of good appearance and safety during the construction period.

Prior to final acceptance of the Work the Contractor shall have completed the leveling and clean-up of the disposal site.

010720 PROJECT RECORD DOCUMENTS

The Contractor shall maintain at the site, available to the Owner and Engineer, one copy of the Contract Documents, Drawings, Shop Drawings, Change Orders, and other modifications in good order and marked to record all changes made during construction. These documents shall be delivered to the Engineer upon completion of the Work.

During the progress meetings, such record documents shall be reviewed to ascertain that all changes have been recorded.

010730 TOUCH-UP AND REPAIR

The Contractor shall touch up or repair finished surfaces on structures, equipment, fixtures, or installations that have been damaged prior to final acceptance. Surfaces on which such touch-up or repair cannot be successfully accomplished shall be completely refinished or in the case of hardware and similar small items, the item shall be replaced.

010740 EQUIPMENT START-UP

After all acceptance tests have been completed by the Contractor and Owner but prior to final acceptance, the Contractor shall recheck all equipment for proper alignment and adjustment, check oil levels, re-lubricate all bearings and wearing points, and in general assure that all equipment is in proper condition for regular continuous operation.

010741 OPERATING INSTRUCTIONS

The Contractor shall not install any item of machinery or process equipment until he has delivered to the Engineer a copy of the manufacturer's installation instructions. Prior to final acceptance the Contractor

shall furnish to the Engineer four complete bound sets of Operating Instructions, Maintenance Instructions, and Parts Lists for all such equipment.

010742 FINAL EQUIPMENT CHECK

After test operation and before final acceptance, or acceptance for the final seven-day test run by the Owner, each piece of machinery shall be lubricated and all components and couplings checked for proper alignment and adjustment.

* * * END OF DIVISION 1 * * *

DIVISION 2

SITWORK

020000 GENERAL

The provisions herein shall apply to all demolition, clearing, grading, excavation, filling, and backfilling, and the construction of all utility lines, fences, roadways, and other construction outside the lines of structures and existing facilities.

Existing improvements, adjacent property, utilities, and other facilities shall be protected from injury or damage resulting from the Contractor's operations.

020001 PROTECTION OF EXISTING FLORA

All trees and shrubs found suitable for improvement and beautification, which will not interfere with excavation or embankment or cause disintegration of the improvements shall not be disturbed. The Contractor shall not damage, disturb, or cause injury to shrubbery, vines, plants, grasses, and other vegetation growing outside of the clearing limits. The dragging and the piling of materials of various kinds and the performing of other work which may be injurious to vegetation shall be confined to areas which have no vegetation or which will be covered by embankment or disturbed by excavation during grading operations.

020002 COMPACTION CONTROL AND TESTING

Maximum density, as used in these Specifications, shall be defined as the maximum density obtained in the laboratory by ASTM D 1557. In-place density of compacted backfill will be determined in accordance with ASTM D 1556, or by nuclear density test procedures in accordance with ASTM D 2922 and ASTM D 3017.

It shall be the responsibility of the Contractor to accomplish the specified compaction for backfill, fill, and other earthwork. It shall be the responsibility of the Contractor to control his operations by confirmation tests to verify and confirm that he has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.

The frequency of Contractor's confirmation tests shall be not less than as follows and each test location for trenches shall include tests for each layer, type, or class of backfill from bedding to finish grade.

A. Trenches:

- | | | |
|----|--|----------------------------------|
| 1. | Open fields | 2 every 2,000 square feet |
| 2. | Along dirt or gravel roads
or off traveled right-of-way | 2 every 500 linear feet |
| 3. | Crossing paved roads | 2 locations along each crossing |
| 4. | Under pavement cuts or within
2 feet of pavement edges | 1 location every 400 linear feet |

- | | |
|------------------------|-------------------------|
| B. Structural backfill | 1 every 20 cubic yards |
| C. Embankment or fill | 1 every 100 cubic yards |
| D. Base material | 1 every 50 cubic yards |

Confirmation tests shall be paid by the Contractor.

Copies of the test reports shall be submitted promptly to the Engineer. The Contractor's tests shall be performed by a soils testing laboratory acceptable to the Engineer.

The Contractor shall demonstrate the adequacy of compaction equipment and procedures before exceeding any of the following amounts of earthwork quantities:

- A. 200 linear feet of trench backfill.
- B. 10 cubic yards of structural backfill.
- C. 100 cubic yards of embankment work.
- D. 50 cubic yards of base material.

Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of the same kind shall be performed.

After satisfactory conclusion of the initial compaction demonstration and at any time during construction, earthwork which does not comply with the specified degree of compaction shall not exceed the previously specified amounts.

Periodic compliance tests will be made by the Engineer to verify that compaction is meeting the requirements previously specified at no cost to the Contractor. For tests in backfill that has been water settled, the Contractor shall remove the overburden above the level at which the Engineer wishes to test and shall backfill and recompact the excavation after the test is complete.

If compaction fails to meet the specified requirements, the Contractor shall remove and replace the backfill at proper density or shall bring the density up to specified level by other means acceptable to the Engineer. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid by the Contractor. The Contractor's confirmation tests shall be performed in a manner acceptable to the Engineer. Frequency of confirmation tests for remedial work shall be double that amount specified for initial confirmation tests.

020003 SOILS REPORT (Geotechnical Study)

A subsurface soils investigation has been prepared for the site for design and is available upon request from Epic Engineering.

The Owner makes no representation as to the correctness of the information contained in the report, nor as to the locations of the boring holes, nor that the report represents a cross section of the material to be encountered in performing excavation and earthwork on the Project. Any use made of the report by the Bidders or the Contractor is at the sole risk of such bidders or the Contractor who have the responsibility

to satisfy themselves independently from other sources regarding the character and amount of rock, gravel, sand, silt, organic materials, groundwater, and all other material to be encountered in the work to be performed.

The use of this report shall be at the Bidders' or the Contractor's discretion. The Bidders or the Contractor shall recognize the fact that the determination of the types and sizes of material was limited by the size of the auger or drill used to drill these holes. Bidders or Contractor shall make whatever other investigations as are necessary in order to determine to their or his satisfaction the conditions that exist.

Bidders shall include in the price bid for the Work all work necessary to perform the tasks required to complete the Work as indicated on the Plans and specified herein; including, but not limited to, sheeting, shoring, blasting, dewatering, and any other work of temporary nature not a part of the permanent work or improvement.

For all other sites there has not been any subsurface soils investigation and the following applies.

The Contractor has the responsibility to satisfy themselves independently from other sources regarding the character and amount of rock, gravel, sand, silt, organic materials, groundwater, and all other material to be encountered in the work to be performed. Bidders or Contractor shall make whatever investigations as are necessary in order to determine to their or his satisfaction the conditions that exist.

Bidders shall include in the price bid for the Work all work necessary to perform the tasks required to complete the Work as indicated on the Plans and specified herein; including, but not limited to, sheeting, shoring, blasting, dewatering, and any other work of temporary nature not a part of the permanent work or improvement.

020200 CLEARING AND GRUBBING

Areas where construction is to be performed and other areas as indicated on the Plans or specified shall be cleared of all fences, lumber, walls, stumps, brush, roots, weeds, trees, shrubs, rubbish, and other objectionable material of any kind which, if left in place, would interfere with the proper performance or completion of the contemplated work, would impair its subsequent use, or form obstructions therein. Organic material from clearing and grubbing operations shall not be incorporated in fills and backfills.

Clearing and grubbing shall be performed in advance of grading operations.

Pits, fill, and other earthwork required for the erection of Contractor's construction facilities shall be filled or removed, as the case may be, upon the completion of the work and leveled to meet the existing contours of the adjacent ground.

020201 STRIPPING

Soil material containing sod, grass, or other vegetation shall be removed to a depth of 6 inches from all areas to receive fill or pavement and all areas to temporarily store excavated material. Topsoil shall be removed from all trenching areas and also the areas where the excavated material and backfill material will be stored or stockpiled. The stripped material shall be deposited in such locations as are acceptable to the Engineer or, if acceptable, the material may be used in the top 6 inches of areas to be used for future planting. Top soil shall be replaced as indicated on the Plans.

The Contractor must be aware that no mixing or contamination of the topsoil will be tolerated. Subsurface material must be kept separate from the topsoil. After replacement of the topsoil there must be no evidence of subsurface material or backfill material.

020300 EARTHWORK

The work covered by this Section of the Specifications consists in furnishing all labor, equipment, supplies, and materials and in performing all operations in connection with the following: loosening, excavating, filling, grading, borrow, hauling, subgrade preparation, compacting in final location, wet and dry, and all operations pertaining thereto for site grading for buildings, basins, reservoirs, boxes, pipelines, roads, and other structures of whatever nature and other purposes; furnishing, placing, and removing of all sheeting and bracing; pumping and draining of excavation; the supporting of structures above and below ground; the handling of all water encountered in the excavations; the backfilling, compacted and loose, around structures and backfilling of all trenches and pits; and all other incidental earthwork as indicated on the Plans, as specified and as required to complete the work ready for final use.

Where mud or other soft or unstable material is encountered, it shall be removed and the space refilled with good clean earth or gravel which can be compacted with no perceptible movement under the roller.

020300.10 EARTHWORK WITHIN ROADWAYS

Earthwork within the rights-of-way of the State Division of Highways, the County Road Department, and the respective cities shall be done in accordance with requirements and provisions of the permits issued by those agencies for the construction within their respective rights-of-way. Such requirements and provisions, where applicable, shall take precedence and supersede the provisions of these Specifications.

020301 WORK SEQUENCE

The Contractor shall schedule the earthwork operations to meet the requirements as provided in these Specifications for excavation and uses of excavated material. If necessary, the Contractor shall stockpile excavated material in order to use it in the specified locations.

020302 CHARACTER AND AMOUNT OF MATERIAL

The Contractor shall satisfy himself regarding the character and amount of rock, gravel, sand, silt, water, and other inorganic or organic material as well as gradation and shrinkage of excavation and fill material, and the suitability of the material for the use intended, and all other material to be encountered in the work to be performed. The quantity of material, and the cost thereof, required for the construction of all excavation and fill, whether from site excavation, borrow or imported material; and/or the wasting of excess material, if required, shall be included in the Contractor's quoted price for construction of the work to be performed under this project.

020303 PROTECTION OF EXISTING STRUCTURES

The Contractor, especially in blasting or in the use of heavy equipment, shall protect existing power lines, roofs, buildings, other structures, and utilities.

020304 FINISH GRADE OF EXCAVATION, BACKFILL, AND FILL

Fine grading under the concrete structures shall be such that the finished surfaces are never above the established grade or approved cross section and are never more than 0.10 feet below. All areas which are not under concrete shall be graded uniformly. The finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from blade grader operations, except as otherwise specified. All gutters and ditches shall be finished so as to drain readily. The finished surface areas outside of structures shall be not more than 0.10 foot above or below the established grade or accepted cross section.

The finished graded surfaces of all areas which will not be under structures, concrete, asphalt, roads, pavements, walks, dikes, etc. shall either consist of undisturbed natural soil, or not less than the top 6 inches shall be cohesive materials. The intent of the preceding is to avoid sandy or gravelly areas.

Newly graded areas shall be protected from the action of the elements, and any settlement or washing that may occur from that or any other cause prior to acceptance of the Work shall be repaired and grades reestablished to the required elevations and slopes.

020305 REMOVAL OF WATER

The Contractor shall provide and maintain at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water entering the excavation or other parts of the work, whether the water be surface water or underground water. No concrete or masonry footings, foundations, or floors shall be laid in water, nor shall water be allowed to rise over them until the concrete or mortar has set at least 24 hours. Water shall not be allowed to rise unequally against walls for a period of 14 days following concrete placement.

The Contractor shall dispose of the water from the work in a suitable manner without damage to adjacent property. The Contractor shall be responsible for obtaining all water discharge permits that are required. No water shall be drained into work built or under construction.

Water shall be disposed of in such a manner as not to be a menace to the public health.

Written permission shall be secured from the Engineer before locating any wells, well points, or drain lines for purposes of dewatering within the limits of a structure foundation. The Engineer shall have the right to require that any dewatering well, line, or French drain left in place within the structure foundation limits be filled with Class C concrete or grout as herein specified.

020320 EXCAVATION

Excavation shall comprise and include the satisfactory loosening, removing, loading, transporting, depositing, and compacting in the final location all materials, wet and dry, necessary to be removed for purposes of construction, or as required for ditches, grading, roads, and such other purposes as are indicated on the Plans; the furnishing, placing, and removing of all sheeting and bracing; all pumping, draining, and handling of water encountered in the excavations; the supporting of structures above and below ground. All excavated materials which are not required for fill and backfill, or which are unsuitable for fill or backfill, shall be disposed of by the Contractor, at his expense and responsibility, and in a manner acceptable to the Engineer.

No surplus material shall be dumped on private property unless written permission is furnished by the owner of the property.

During construction, excavation and filling shall be performed in a manner and sequence that will provide drainage at all times. Material required for fills in excess of that produced by excavation shall be obtained from borrow areas as specified herein.

Topsoil, and suitable excavated material required for fill under slabs, shall be separately stockpiled as directed by the Engineer.

Rocks, broken concrete, or other solid materials, which are larger than 4 inches in greatest dimension shall not be placed in fill areas and shall be removed from the site by the Contractor at no additional cost to the Owner.

020322 EXCAVATION SUPPORT

A. General: Contractor shall support the faces of excavations and shall protect structures and improvements in the vicinity of excavations from damage due to settlement of soils and alternations in the ground water level caused to such excavations and related operations.

1. The provisions specified hereunder shall be understood:
 - a. To complement, and not to substitute or diminish, the obligations of Contractor for the furnishing of a safe place of work pursuant to the provisions of the Occupational Safety and Health Act of 1970 and its subsequent amendments and regulations and for the protection of the Work, structures, and other improvements.
 - b. To represent a minimum requirement:
 - 1) For the number and types of means needed to maintain soil stability.
 - 2) For the strength of such required means, and
 - 3) For the methods and frequency of maintenance and observation of the means used for maintaining soil stability.
2. Excavation support shall include sheeting, shoring, bracing, sloping, and other means and procedures, such as draining and recharging groundwater and routing and disposing of surface runoff, required to maintain the stability of soils.

B. Contractor shall provide excavation support in trenches for the protection of workers from the hazard of caving ground.

C. Excavation supports shall be provided:

1. Where, as a result of excavation work and an analysis performed pursuant to general engineering design practice, as defined hereinafter:
 - a. The excavated face or surrounding soil mass may be subject to slides, caving, or other type of failure, or
 - b. The stability and integrity of structures and other improvements may be compromised by settlement or shifting of soils.
2. For trenches 5 feet and deeper.
3. Where indicated on the Drawings.

D. References:

1. American Institute of Steel Construction, Inc., Manual of Steel Construction, herein referenced as the Steel Manual.
2. International Conference of Building Officials, Uniform Building Code, herein referenced as the UBC.

E. Definitions: As used under this title of Excavation Support, general engineering design practice shall be understood to mean the general engineering design practice in the area of the Project performed in accordance with recent literature on the subject of excavation support.

1. Where general engineering design practice is specified it shall be understood that the design shall be performed, and the drawings and calculations shall be signed, by a civil or structural engineer registered in the State where the Project is located.
 - a. The design calculations shall disclose clearly the assumptions made, the criteria followed, and the stress values used for the various materials.
 - b. Where requested by Engineer, Contractor shall furnish acceptable references substantiating the appropriateness of the design assumptions, criteria, and stress values.

F. Submittals:

1. For trench excavation, Contractor shall submit, in advance of excavation of trenches 5 feet or more in depth, detailed plans showing the design of excavation support for worker protection.
 - a. The design shall be performed pursuant to general engineering design practice, as defined hereinbefore.
2. For excavations other than trenches, Contractor shall submit:
 - a. An analysis performed pursuant to general engineering design practice, as specified hereinbefore, identifying the conditions under which excavation support will be required. This analysis shall be submitted in advance of and shall cover:
 - 1) Excavations 2 feet or more in depth adjacent to structures, and
 - 2) Excavations 5 feet or more in depth at other locations.
 - b. For excavations that will require excavation support, in accordance with the determination made under the preceding subparagraph a., Contractor shall submit excavation support design and details pursuant to general engineering design practice, as specified hereinbefore.
 - 1) The same procedure shall be followed for subsequent changes to the excavation support design.
3. Pursuant to provisions specified hereinafter, Contractor shall submit the location and details of control points and method and schedule of measurements.
4. Promptly upon performance of the measurements of control points specified hereinafter, Contractor shall submit a copy of the field notes with such measurements.

G. Design Criteria:

1. Excavation support shall be designed in accordance with general engineering design practice.

2. Steel members shall be designed in accordance with the Steel Manual.
 3. Design involving materials other than steel shall be in accordance with the UBC.
 4. Excavation support shall be designed in accordance with soil characteristics and design recommendations contained in a written report issued and signed by a civil or soil engineer registered in the state where the Project is located.
 - a. A copy of the written report shall be available at the site of the Project for Engineer's review.
 - b. The civil or soil engineer shall be retained by Contractor.
 5. Where Contractor elects to design excavation support allowing materials to bear stresses higher than those prescribed in the referenced publications, the increase in such stresses shall not exceed 10 percent of the value of the prescribed stresses.
 6. Where shoring is indicated on the Drawings, no other types of excavation support shall be used.
- H. Performance Requirements: Appropriate design and procedures for construction and maintenance shall be used to minimize settlement of the supported ground to prevent damage to existing structures and other improvements. Such design and procedures shall include:
1. Using stiff support systems.
 2. Following an appropriate construction sequence.
 3. Preventing soil loss through or under the support system.
 - a. The support system shall be tight enough to prevent loss of soil and shall be extended deep enough to prevent heave or flow of soils from the supported soil mass into the excavation.
 4. Providing surface runoff routing and discharge away from the excavations.
 5. Recharging groundwater, where necessary.
 - a. Where dewatering is necessary, Contractor shall recharge the groundwater as necessary to prevent settlement in the area surrounding the excavation.
 6. Not anchoring the support system to structures and other improvements.
 7. Not applying support system loads to structures and other improvements.
 8. Not changing existing soil loading on structures and other improvements.
- I. Installation:
1. Excavation support shall be installed as indicated in the approved submittals.
 2. Excavation, including trenching, shall not begin until the excavation support submittals have been approved by the Engineer and until the materials necessary for the installation are on site.

J. Maintenance:

1. Where loss of soil occurs, Contractor shall plug the gap in the support system and shall replace the lost soil with suitable fill material.
2. Where measurements and observations indicate the possibility of failure of the excavation support, determined in accordance with general engineering design practice, Contractor shall take appropriate action immediately.
3. Control Points:
 - a. Contractor shall establish control points on the support system and on structures and other improvements in the vicinity of the excavation for measurement of horizontal and vertical movement.
 - 1) Control points in the support system shall be set at distances not exceeding 25 feet at each support level. Support levels shall be the levels of tie-backs, walers, bottom of excavation, and other types of supports.
 - 2) Control points shall be set in corners of structures and on curbs, manholes, and other locations indicated on the Plans.

020324 EXCAVATIONS FOR BUILDINGS AND STRUCTURES

The excavation shall conform to the dimensions and elevations indicated on the Plans for each building and structure and shall include trenching for adjacent piping and all work incidental thereto. In locations where soil of suitable bearing value is encountered at a different elevation from that indicated on the Plans, the Engineer may direct in writing that the excavation be carried to elevations above or below those indicated on the Plans. Unless so directed by the Engineer, excavation shall not be carried below the elevations indicated on the Plans. Where the excavation is made below the elevations indicated on the Plans or directed by the Engineer, the excavation, if under slabs, shall be restored to the proper elevation in accordance with the procedure hereinafter specified for backfill; or if under footings, the heights of the walls or footings shall be increased, or space shall be refilled with Class C concrete at the expense of the Contractor, as may be directed by the Engineer. Excavation shall extend at least 24 inches in the clear from walls and footings to allow for placing and removal of forms, installation of services, and inspection. Undercutting will not be permitted.

The bottom of the excavation for a structure shall consist of native material with the top 6 inches compacted to 95 percent of maximum density and graded to conform to the outside limits of the structure as indicated on the Plans, except where indicated otherwise on the Plans or in the Specifications. No extra compensation will be made for removal of rock or any other material due to difficulty of excavation.

Where a structure would be located partially on fill and partially on undisturbed or natural material, the entire area shall be over-excavated to a depth of 6 inches below the elevations indicated and recompacted to 95 percent maximum density.

020327 DITCHES AND GUTTERS

Ditches and gutters shall be cut accurately to the cross sections and grades indicated on the Plans. Care shall be taken not to excavate ditches and gutters below the grades indicated. Any excessive ditch and gutter excavation shall be backfilled to grade either with suitable, thoroughly compacted material or with suitable stone or cobble to form an adequate gutter paving as directed. The Contractor shall maintain all ditches and gutters excavated under this Contract free from detrimental quantities of debris until final

acceptance of the Work. No material shall be deposited within 3 feet of the edge of a ditch unless otherwise indicated on the Plans.

020330 COMPACTED FILLS

Fills, embankments, or backfills (except trench backfills specified elsewhere), herein designated as fills, shall be constructed at the locations and to the lines and grades indicated on the Plans. The completed fill shall correspond to the shape of the typical sections on the Plans or shall meet the requirements for the particular case. Material for fills shall be obtained from cut sections or borrow from a source as selected by the Contractor and accepted by the Engineer. Maximum particle size shall not exceed 3 inches. The fill material shall be free of leaves, grass, roots, stumps, and other vegetable matter. Unless otherwise indicated on the Plans, the areas to receive fill material shall be scarified to a minimum depth of 6 inches and recompacted to the density of the fill material density specified in the following.

Unless otherwise indicated, fills and backfills and the upper 6 inches in cuts shall be compacted to the percentage of maximum density specified in the following tabulation:

<u>Location</u>	<u>Percent</u>
Backfill adjacent to structures	95
Under structures (present and future)	95
Under roadways, parking, storage areas, curbs, and sidewalks	90
Other areas	85

All compacted fills shall be placed in successive layers of loose material not exceeding 6 inches in depth after compaction. Each layer shall be brought to optimum moisture content for maximum density before compaction by rolling. If any material is placed that does not have the correct moisture content, it shall be removed and replaced. Soft, spongy, or springy material causing areas that "pump" when heavy loads pass over them shall be removed and replaced with suitable material. Dry material that will not "ball" shall be removed and replaced. These two conditions shall be considered as sufficient evidence without further testing that the moisture content is not correct and the material shall be removed.

Each layer shall be spread uniformly by the use of a road machine or other accepted device and rolled with an acceptable tamping roller, heavy pneumatic roller, or 3-wheeled power roller until thoroughly compacted to not less than the specified density.

Fill that is to be compacted and is inaccessible to rollers shall be compacted with pneumatic, vibrating, or other tamping equipment.

It shall be the responsibility of the Contractor to accomplish the specified compaction for backfill, fill, and other earthwork. It shall be the responsibility of the Contractor to control his operations by confirmation tests to verify and confirm that he has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.

The use of trucks, carryalls, scrapers, tractors, or other heavy hauling equipment shall not be considered as rolling in lieu of rollers, but the traffic of such hauling equipment shall be distributed over the fill in such a manner as to make use of the compaction afforded thereby as an addition to compaction by the use of rollers.

Where fill will not be under or adjacent to a wall or slab, under a paved area, under or in an area of compacted fill or embankment, or is not otherwise specified to have compaction to 95 percent of maximum density, the Contractor may backfill the first 2 feet above the bottom of the excavation by the method described above and proceed to the top of the fill in not less than three lifts placed as follows:

- A. Each lift shall be consolidated by first filling to the lift height with water and subsequently depositing sufficient granular material as defined herein under SELECT MATERIAL to absorb the water deposited to such extent that water is still evident on the entire surface before proceeding with the next lift.
- B. The filling of the soil to absorb the water shall be done gradually, to insure that the soil is uniformly wetted and to preclude the possibility of a large amount of soil displacing the water to the top.
- C. The Engineer reserves the right to require that the filling be done by hand, if use of mechanical equipment results in incomplete wetting of the material and improper compaction.
- D. Each lift shall be leveled by poling or tamping prior to the application of water for the following lift. Each lift shall be examined to determine if all the earth is saturated.

020331 BACKFILL AND BASE MATERIALS

Sand, untreated base course (UBC) material, gravel fill, drain rock, select material, and native material, where required for fill, backfill, bedding, and/or backfill around pipe and trench backfill shall conform to the following specifications.

020331.10 SAND

The sand used for bedding under and around the pipe shall be clean, coarse, natural sand which shall be non-plastic when tested in accordance with ASTM D 431B and 100 percent shall pass a 1/2-inch screen and no more than 20 percent shall pass a No. 200 screen.

020331.20 BASE MATERIAL

The material shall consist of hard, durable particles or fragments of stone or gravel, screened or crushed to the required size and grading. The material shall be free from vegetable matter, lumps or balls of clay, alkali, adobe, or other deleterious matter, and shall conform to the following gradations when tested in accordance with AASHTO T-27 or ASTM C 136 and AASHTO T-11 or ASTM C 117. Where indicated on the Plans for structures, compacted gravel fill shall be compacted untreated base course (UBC) material compacted to not less than 95 percent of maximum density.

Sieve Sizes (Square Openings)	Percentage By Weight Passing Sieve		
	Gravel Fill		(UBC) Aggregate Base
	Type A	Type B	
3-inch	100		
1-1/2-inch		100	
1-1/8-inch			100
No. 4	30- 75	30- 70	38- 65
No. 8	20- 60	20- 60	25- 60
No. 30	10- 40	10- 40	10- 40

In addition to the above requirements, all material, when sampled and tested in accordance with standard test methods, the aggregate shall meet the following requirements:

PERCENTAGE OF WEAR: When tested in accordance with ASTM C 131, the percentage of wear shall not exceed 40 percent after 500 revolutions.

PLASTICITY INDEX: When tested in accordance with AASHTO T-90 or ASTM D 431B, the plasticity index shall not be more than 5.

LIQUID LIMIT: When tested in accordance with AASHTO T-89 or ASTM D 431B, the liquid limit shall not be more than 25 percent.

Untreated base course (UBC) for structures shall consist of crushed or fragmented particles. At the option of the Contractor, other base material shall be either crushed or natural material aggregate. The aggregate shall conform to the sieve analysis in this Specification except that the least dimension of the maximum particle size shall not exceed 2/3 of the compacted thickness of the specified lift being placed.

020331.30 SELECT MATERIAL

Select material as specified herein shall mean sound earthen material conforms to classification A-1-a or A-1-b, 2-inch maximum, nonplastic of AASHTO M-145.

020331.40 NATIVE MATERIAL

Native material as specified herein shall mean sound, earthen material substantially free of debris, organic matter, and oversized material (greater than 3-inch diameter) with a fines content greater than 30% (passing No. 200 sieve), or as approved by the Engineer.

020331.41 IMPORT ENGINEERED MATERIAL

Import Engineered material as specified herein shall mean sound earthen material conforms to classification A-1-a or A-1-b, 4-inch maximum, nonplastic of AASHTO M-145.

The Contractor will be responsible for loading, transporting and adjusting the moisture content of all material installed in the trench. The Contractor shall be responsible for providing their own proctors for use during backfill compaction testing.

020331.50 DRAIN ROCK

The materials shall consist of hard, durable particles of stone or gravel, screened or crushed to the required size and grading. The material shall be free from vegetable matter, lumps or balls of clay, or other deleterious matter and shall conform to the following gradings when tested in accordance with AASHTO T-27 or ASTM C 136.

<u>Sieve Size (Square Opening)</u>	<u>2-inch Crushed Drain Rock Percent By Weight Passing Screen</u>	<u>3/4-inch Crushed Drain Rock Percent By Weight Passing Screen</u>
2-inch	100	--
1-1/2 inch	95-100	--
3/4-inch	50-100	100
3/8-inch	15-55	15-55
No. 4	0-25	0-25
No. 8	0-5	0-5
No.200	0-3	0-3

Coarse material shall be crushed or wasted and fine material shall be wasted to meet the grading requirements set forth above.

Coarse aggregate, retained on the No. 4 sieve, shall have a percentage of wear not greater than 40 percent when tested by the Los Angeles Test, AASHTO T-96 or ASTM C 131.

020331.60 BEDDING MATERIAL

Bedding material for DIP, PVC, Welded Steel, or HDPE shall be a clean, coarse, natural sand. Bedding shall be tamped or compacted to a minimum of 90 percent T-99 lab density or as otherwise specified on the plans.

Bedding material for RCP shall be Select Material as defined in section 020331.30.

020332 PREPARING GROUND SURFACES FOR FILL

After clearing is completed, the entire area which will underlie fill sections or structures shall be scarified to a depth of 6 inches and until the surface is free of ruts, hummocks, and other features which would prevent uniform compaction by the equipment used. The areas shall be recompacted to the density specified for COMPACTED FILLS before placing of fill material or concrete, as the case may be.

Where cemented rock, cobbles, or boulders compose a large portion of the foundation material underlying structures, slabs, or paved areas, it may not be advisable to scarify the top 6 inches prior to compaction. If the Engineer deems it advisable not to scarify the existing natural ground, the Contractor shall moisten the native soil and compact it as specified below in the following for coarsely graded material.

Foundations for fill having slopes in excess of one vertical to four horizontal shall be benched or terraced to adequately key the existing ground and the fill built thereon. The slopes of original hillsides and old fills shall be benched a minimum of 4 feet horizontally as the fill is placed. A new bench shall be started wherever the vertical cut of the next lower bench intersects the existing ground. Material thus cut out shall be recompacted along with the new embankment material by the Contractor at no additional cost to the Owner.

020333 COMPACTION OF COARSE FILL

In the case of materials too coarsely graded to perform field density tests, the material shall be placed in lifts so as to obtain a compacted thickness of 6 inches and rolled with a minimum of five passes with pneumatic roller A or seven passes with pneumatic roller B as defined below. One pass shall be defined as one movement of a roller over the area being compacted. The width of a pass shall be measured between the centers of the outside tires. The moisture content of the fraction of the material passing a 3/4-inch sieve shall be within plus or minus 2.0 percent of optimum moisture as determined in accordance with ASTM D 1557, Method C.

The pneumatic tired roller shall be defined as a roller meeting with one of the following specifications:

<u>Roller</u>	<u>Roller Rating</u>	<u>Wheel Load</u>	<u>Tire Inflation Pressure</u>
A	45 ton min.	11.0 ton min.	140 psi min.
B	45 ton min.	5.5 ton min.	90 psi min.

There will be no variation in the number of passes required regardless of fill location.

020334 BACKFILL AROUND STRUCTURES

After completion of foundation footings and walls and other construction below the elevation of the final grades and prior to backfilling, all forms shall be removed and excavation shall be cleaned of all trash and debris. Backfill in any area under concrete structures, under pavement, or where mechanized heavy compaction equipment, such as a pneumatic tired roller, cannot be used satisfactorily shall consist of UBC material as specified for untreated base course. Material for backfilling outside of, but adjacent to, structures, and not specified otherwise above, shall consist of select material passing a 1-1/2-inch screen or of imported sand, gravel, or other materials acceptable to the Engineer. All backfill material shall be free of trash, roots, lumber, organic matter, or other debris. The backfill material in confined areas shall be compacted with pneumatic, vibrating, or other acceptable tamping equipment to the density specified for COMPACTED FILLS in this Section. After inspection of foundations, walls, and pipes, backfill shall be placed symmetrically to prevent eccentric loading upon or against structures.

All backfill, whether adjacent to structures, in trenches, or in other areas, shall be compacted to the density specified under COMPACTED FILLS.

020335 EMBANKMENTS AND ROADWAY FILLS

Compacted embankments or roadway fills, constructed in layers of the depths specified above, shall be compacted by rolling with power rollers weighing not less than 10 tons, with tamping rollers, with vibrating rollers or with pneumatic tire rollers. While and as each layer is deposited, water shall be applied in sufficient amount to ensure optimum moisture to secure the compaction specified. If excess moisture is encountered in the fill, each layer shall be manipulated so as to dry out excess moisture. The water shall be uniformly incorporated with the fill material in an amount sufficient to assure the required density after rolling.

Unless otherwise specified or indicated on the Plans, material for construction of embankments and roadway fills may be surplus material from excavation for structures or other construction or, if approved by the Owner, borrow material excavated from a source within the Project site. Whatever the source, the fill material shall conform with specified requirements. The Contractor shall obtain acceptable material from other sources if surplus or borrow materials obtained within the Project site do not conform to the specified requirements or are not sufficient in quantity for construction of embankments and roadway fills.

Embankments or roadway fills shall be constructed in layers for the full width of the fill. Material first placed in the fill in piles or windrows shall be distributed by blading or similar methods to break up clods or lumps and spread out the material. Where the subgrade material is unsuitable, it shall be removed to a depth not less than 12 inches below the subgrade elevation and replaced with satisfactory materials.

No extra compensation will be made for hauling of fill materials nor for water required to compact the fill. Water from an acceptable source shall be used for compacting fill, and the Contractor shall, at his own expense provide such means or facilities as are required for transporting water.

No material shall be placed beyond the sloping lines of embankment. Material allowed to be placed beyond the lines of embankment indicated on the Plans will not require compaction and will be placed only for the purpose of wasting surplus material should the Engineer select the embankments as a location for wasting material.

020340 TRENCH EXCAVATION

Pipe and electrical conduits shall be laid in an open trench. If the bottom of the excavation is found to consist of rock or any material that by reason of its hardness cannot be excavated to give a uniform bearing surface, said rock or other material shall be removed to a depth of not less than 3 inches below the bottom of the pipe and refilled to grade with UBC material or sand placed at a uniform density, with minimum possible compaction, all at the Contractor's expense.

If the bottom of the excavation is found to consist of soft or unstable material which is incapable of properly supporting the pipe, such material shall be removed to a depth required and for the lengths required and the trench refilled to grade with UBC material or sand, compacted to 90 percent of maximum density. Where indicated on the Plans, pipe shall be cradled in concrete.

The minimum clear width of the trench for pipe 4 inches in diameter and over, measured at the top of the pipe, shall be not less than the outside diameter of the pipe plus 18 inches. The maximum clear width of the trench for pipe, measured at the top of the pipe, shall not exceed the outside diameter of the pipe plus 24 inches for pipe sizes up to and including 24 inches and shall not exceed the outside diameter of the pipe plus 36 inches for pipe sizes over 24 inches.

Excavation for manholes, valves, or other accessories shall be sufficient to leave at least 12 inches in the clear between their outer surfaces and the embankment or timber which may be used to hold the banks and protect them. Backfill with earth under manholes, vaults, tanks, or valves will not be permitted. Any unauthorized excess excavation below the elevation indicated for foundation of any structure shall be filled with sand, base material, or concrete, at the expense of the Contractor. Backfilling of manhole excavation shall conform to the backfilling required for trenches.

If, because of soil conditions, safety requirements or other reasons, the trench width at top of pipe is increased beyond the width specified in the preceding paragraphs, laying conditions shall be upgraded or stronger pipe installed, designed in conformance with the Specifications for the increased trench width, without additional cost to the Owner.

Before laying pipes or electrical conduits that are to be in fill, the fill shall first be placed and compacted to not less than 2 feet above the top of pipe or conduit. After the placing and compacting of the fill, the trench for the pipe or conduit shall be excavated through the fill and fine graded as required hereinafter.

Potable water pipe and appurtenances shall be laid in trenches separate from those used for sewers. Unless otherwise specified or indicated on the Plans, potable water pipe shall be laid in trenches having a cover of not less than 4 feet below the surface of the ground and located at a distance of not less than 10 feet from any parallel sewer trench.

At road crossings or where existing driveways occur on a road, the Contractor shall make provision for ditch crossings at these points, either by means of backfills, tunnels, or temporary bridges.

020342 FINE GRADING

Unless otherwise specified in the Contract Documents, the bottom of the trench for pipes 16 inches in nominal diameter and under shall be accurately graded to provide uniform bearing and support for each section of the pipe, on undisturbed soil at every point along its entire length, except for portions of the pipe where it is necessary to excavate for bells and for the proper sealing of pipe joints.

For all pipe over 16 inches in diameter, the Contractor shall over excavate the bottom of the trench by at least 4 inches, or 1/12 the outside diameter of the pipe, whichever is greater. This overcut shall be filled with bedding material consisting of select material or sand as specified herein, and fine graded as specified above. This bedding material shall be placed at a uniform density, with minimum possible compaction.

Where the trench excavation is made below the grade required to accommodate the bedding material, the trench bottom shall be restored to the proper grade by backfilling and compacting the backfill to 95 percent of maximum density, at the expense of the Contractor. Backfill material shall be select material as specified herein.

Bell or coupling holes shall be dug after the trench bottom has been graded. Such holes shall be of sufficient width to provide ample room for caulking or banding.

Bell and coupling holes shall be excavated only as necessary to permit accurate work in the making of the joints and to ensure that the pipe will rest upon the prepared bottom of the trench, and not be supported by any portion of the joint.

Depressions for joints, other than bell-and-spigot, shall be made in accordance with the recommendations of the joint manufacturer for the particular joint used.

020344 PIPE BEDDING

Four inches of bedding material shall be placed and shaped for the pipe and bells and compacted. Bedding material shall not be placed in free standing water.

After the pipe is laid, bedding material shall be placed under and around the pipe to a level even with the spring line of the pipe, compacted to 90 percent of maximum density. The section of trench from the spring line to 12 inches above the top of the pipe shall then be filled with bedding material and water settled or compacted to 90 percent of maximum density. The Contractor shall take all necessary precautions in the placement and compaction of the bedding material to prevent displacement of the pipe. In the event there is movement or floating, the Contractor shall, at his own expense, re-excavate, re-lay, and backfill all pipe so affected. Consolidation, when acceptable to the Engineer, shall be performed by flooding and poling, or jetting so as to obtain a compaction of the fill material at least equal to that specified. When flooding, poling, or jetting methods are used, material for use as backfill shall be placed and consolidated in layers not exceeding 4 feet in thickness. Flooding and poling, or jetting methods shall be supplemented by the

use of vibratory or other compaction equipment when necessary to obtain the required compaction. Water settling methods shall not be used when the backfill material is not sufficiently granular in nature to be self-draining during and after consolidation and when foundation materials may be softened or otherwise damaged by applied water.

After filling the trench to a level 12 inches above the top of the pipe, the Contractor has the option to water test the pipe or to backfill to the surface, at his own risk, before testing. If the pipe does not pass the hydrostatic test, he shall uncover the pipe, locate the leaks, repair and retest, repeating until the pipe section under test passes the hydrostatic test, all at the Contractor's expense.

020345 TRENCH BACKFILL

The trench backfill from 12 inches above the top of the pipe to the natural surface level or the finished grade indicated on the Plans shall be placed and compacted as follows:

Backfill for trench cuts across roadways and paved streets shall consist of backfilling the trench from 12 inches above the top of the pipe to the surface or to the underside of the specified pavement replacement with untreated base course (UBC) material compacted to 95 percent of maximum density.

Trench backfill for longitudinal trench cuts in roadways, paved areas, and storage areas shall consist of backfilling the trench from 12 inches above the top of the pipe up to within 2 feet of finished grade with native material compacted to 90 percent of maximum density. Backfill from 2 feet below finished grade to finished grade, to the underside of specified aggregate base course material as indicated on the Plans, or to the underside of specified pavement replacement shall consist of native material, untreated base course (UBC) material, or select material compacted to 95 percent of maximum density.

Trench backfill for trench cuts in areas outside the traveled right-of-way and in open country shall consist of backfilling the trench from 12 inches above the top of the pipe to finished grade with native material compacted to 85 percent of maximum density.

It shall be the responsibility of the Contractor to be assured that the native material, when used as previously specified, is capable of being compacted to the degree specified. If the native material cannot be compacted to the density as previously specified, it shall be the Contractor's responsibility to remove and dispose of this material whether it has been placed in the trench as backfill or not, and to utilize other backfill material from another source acceptable to the Engineer, at no extra cost to the Owner.

Where existing underground pipes or conduits larger than 3 inches in diameter cross the trench above the new work, the backfill from the bottom of the trench to the spring line of the intersecting pipe or conduit shall be aggregate base course material compacted to 90 percent of maximum density. The aggregate base course material shall extend 2 feet on either side of the intersecting pipe or conduit to ensure that the material will remain in place while other backfill is placed.

Excess material shall be rounded up in a neat mound over the trench or removed as directed by the Engineer.

020347 PAVEMENT REMOVAL AND REPLACEMENT

Replacement of street, driveway, alley entrance, and other type pavements shall be of the same material as the existing pavement, constructed in accordance with the applicable Plans and Specifications.

The Contractor shall install temporary asphalt pavement or the first course of permanent pavement replacement immediately following backfilling and compaction of trenches that have been cut through existing pavement. Except as otherwise provided, this preliminary pavement shall be maintained in a safe and reasonably smooth condition until required permanent pavement is installed. Temporary paving removed shall be hauled from the jobsite and disposed of at the Contractor's expense.

Where a longitudinal trench is partly in pavement, the pavement shall be replaced to the original pavement edge, on a straight line, parallel to the center line of the roadway.

Where no part of a longitudinal trench is in the pavement, surfacing replacement will only be required where existing surfacing materials have been removed.

When the trench cut is in aggregate surfaced areas, the replacement shall be of aggregate base course material compacted to 95 percent of its maximum density. Aggregate shall match existing aggregate.

020347.01 ASPHALT PAVEMENT REPLACEMENT

Asphalt pavement replacement shall be of the same thickness as the adjacent pavement and shall match as nearly as possible the adjacent pavement in texture, unless otherwise indicated on Plans.

Existing asphalt pavements to be removed for trenches or other underground construction or repair shall be saw cut making a neat, reasonably straight and smooth cut without damaging adjacent pavement that is not to be removed. The cutting device operation shall be subject to the approval of the Engineer.

The existing pavement shall be cut and trimmed after placement of required UBC and just prior to placement of asphalt concrete for pavement replacement, and the trimmed edges shall be painted with a light coating of asphalt cement or emulsified asphalt immediately prior to constructing the new abutting asphalt pavements. No extra payment will be provided for these items, and all costs incurred in performing this work shall be incidental to pipe laying or pavement replacement.

Asphalt pavement replacement shall conform to the contour of the original pavement. A 10-foot straightedge shall be laid parallel to the center line of the trench when the trench is running parallel to the street and across the pavement replacement when the trench crosses the street at an angle. Any deviation in the cut pavement replacement and the old pavement greater than 1/4-inch in 10 feet (10-foot straightedge) shall be removed and corrected.

020347.02 CURB, GUTTER, AND SIDEWALK REPLACEMENT

Where any concrete curb, gutter, or sidewalk has been removed or displaced, the same shall be replaced to the nearest construction joints with new Class A curb, gutter, or sidewalk to the same dimensions and finish as the original construction that was removed.

Expansion joints shall be the same spacing and thickness as on the original construction.

020360 TUNNELING, JACKING, AND BORING

020361 TUNNELS

Tunnels shall be used only when requested by the Contractor in writing and accepted by the Engineer. The tunnel length shall in no case be more than 14 feet, and open trenches between tunnels shall be not less than 8 feet in length.

Tunnels shall have a height which will provide sufficient clear space above the top of the pipe to allow proper workmanship. In no case shall this be less than 2 feet.

020362 JACKING OR BORING PIPE

Steel casing pipes shall have an internal diameter as indicated on the Plans and shall be within 1-1/2 percent of being a true circle. The wall thickness shall be as indicated on the Plans.

Bidders shall make their own investigations and form their own estimates of the soil conditions.

The Contractor or his proposed subcontractor shall provide proof of having sufficient equipment and experience to perform the jacking contract. The Contractor shall submit a list of the equipment to be used in the work together with bona fide evidence of his having successfully completed at least three projects of similar diameter, length, soil, and installation conditions.

Jacking or boring pits shall be located where indicated on the Plans or as designated herein. When no such locations are given, the Contractor shall have the option of determining such locations, subject to acceptance by the Engineer.

The Contractor shall have jacks of sufficient size to move the pipe to its greatest distance from the jacking pit. Contractor also shall have sufficient bracing to withstand the pressure generated by the jacks when jacking the pipe for its total length. The horizontal boring machine shall be capable of boring to the diameter and length as required, maintaining grade and alignment within the given tolerances.

Steel pipe shall be within the tolerances required as indicated on the Plans. The carrier pipe shall then be pushed through the steel casing pipe, each joint being made as the pipe is being inserted. The carrier pipe shall have proper shims or space under it to assure a straight and even grade to its invert. The void between the steel casing and the carrier pipe shall then be filled completely with pneumatically placed pea gravel.

020400 ASPHALT REPLACEMENT

The Contractor shall not damage adjacent concrete surfaces that are not scheduled for removal. Asphalt surfaces that are damaged by removal operations will be restored by the Contractor at no additional cost.

Existing asphalt pavements to be removed shall be saw cut to full depth, making a neat and reasonably straight and smooth cut without damaging adjacent pavement that is not to be removed. The cutting device operation shall be subject to the approval of the Engineer.

020410 REMOVAL OF ASPHALT PAVEMENT

Removal of asphalt pavement shall be by grinding machine according to APWA Standard Specifications, Section 02 41 14 Pavement Removal.

020420 PROOF ROLL EXISTING BASE COURSE

After removal of existing asphalt, the Contractor shall proof roll existing base course to assist the Owner

in confirming and/or identifying areas requiring over-excavation and replacement of subgrade materials.

020600 PAVING AND SURFACING

The Contractor shall construct the roads, pavements, parking areas, and walks in accordance with the notes, grades, and typical sections indicated on the Plans, and shall conform to all applicable requirements specified elsewhere herein in addition to the following specific requirements. Roads shall have parabolic crowns as indicated on the Plans, except where noted otherwise. The finished surface in such areas as are so indicated on the Plans shall be aggregate base course. Elsewhere the finished surface shall be asphalt concrete of the width and thickness indicated on the Plans.

All equipment proposed to be used in the construction of this improvement shall be in good condition, capable of performing the work intended in a satisfactory manner.

Prior to placement of asphalt concrete, the Contractor shall submit to the Engineer for review and acceptance full details, including design and calculations for the asphalt concrete mix he proposes to use.

020601 LIMITING DIMENSIONS

It is the Contractor's responsibility to satisfy himself as to the exact lengths and dimensions of such roads, pavements, parking areas, and walks. Terminals of all surfacing indicated on the Plans shall join existing surfaces in a smooth juncture.

020602 WEATHER LIMITATIONS

Asphalt concrete shall be constructed only when the surface is dry, when the atmospheric temperature in the shade is 40 degrees F and rising, or above 50 degrees F if falling. No asphalt concrete shall be placed when the weather is foggy or rainy or when the base on which the material is to be placed is in a wet or frozen condition.

020603 RESTORING SURFACES

All roads and paved surfaces in which the surface is broken into or damaged by the installation of new work shall be resurfaced in kind, in accordance with the details on the Plans and as specified herein.

020604 GRADING UNDER PAVEMENT

All trees, stumps, brush, roots, sod, vegetation, rubbish, debris, and other objectionable matter shall be removed as previously specified from all areas to be paved.

All areas cleared and grubbed shall be acceptable to the Engineer before the start of grading operations.

The Contractor shall not pass equipment over any pipe, drain, utility line, duct, or structure before it is protected by ample fill material, properly compacted. Any damage to such facilities shall be promptly repaired by the Contractor at his own expense.

The subgrade shall be brought to the required grades and cross sections by excavating, filling, blading, and compacting in accordance with these specifications.

The finished surface of the subgrade, after compaction, shall be smooth and not vary more than 3/4-inch when tested with a 10-foot straightedge, nor vary more than 3/4-inch from true grade as established by grade stakes or forms.

The subgrade shall be kept well drained at all times. Whenever ruts or low spots are formed, the subgrade shall be brought to grade and, if necessary, shall be reshaped and recompacted. Storage or stockpiling of materials on the subgrade will not be permitted.

020610 CONSTRUCTION METHODS

No aggregate base course material shall be placed on the subgrade until it has been checked and accepted by the Engineer.

If required, the soil shall be sterilized in accordance with these specifications.

Aggregate base material shall be placed on the subgrade in uniform layers not to exceed 6 inches in compacted depth. The minimum compacted thickness of each layer should be no less than two times the size of the largest aggregate particle. In no instance shall the minimum depth of a layer be less than 2 inches. Each layer shall be bladed to a smooth surface and shall be consolidated to the densities hereinafter specified.

The material shall be so handled as to avoid segregation of size and shall be mixed, after the addition of water on the roadway, before spreading. When spread, the material shall be free of pockets of coarse or fine materials.

Prior to final compaction, the surface of the aggregate base course shall be shaped to grade and cross section, as indicated on the Plans.

Aggregate base course material under roads and pavements shall be compacted to not less than 95 percent of maximum density, and under walks shall be compacted to not less than 85 percent of maximum density.

020611 SHOULDERS AND DITCHES

All road shoulder construction shall be done in the proper sequence with any base or surface course construction as indicated on Plans or directed by the Engineer. The construction shall be so carried on that the subgrade, shoulders, and adjacent slopes and ditches will at all times be drained effectively and adequately.

The completed shoulders shall be true to alignment and grade, shaped to drain, and in conformity with the sections indicated on the Plans. Completed shoulders shall be kept free of any extraneous accumulations, shall be cleaned and reconditioned when necessary, and shall be maintained until the final inspection and acceptance of the Work. The shoulders shall be compacted as specified for subgrade preparation for paved areas. Any native material on the site other than clay may be used for their construction, provided that fragments larger than 2 inches are not used near or on the surface, and further provided that sufficient binder material is used to secure a hard safe driving surface.

The terms "blade ditch," "grader ditch," or other terms defining ditches, shall not limit the ways and means by which a ditch shall be shaped. Ditches may be hand dug and shaped, blasted, or shaped by any method to secure the desired dimensions and shape indicated on the Plans.

Ditches or excavation required to "daylight" to drain culverts, or to form a proper entrance to culvert structures, shall be included in this work whether or not indicated on the Plans. Ditches or excavation

required for this purpose shall have a grade not less than the grade of the culvert pipe and shall have side slopes not steeper than 45 degrees.

020620 PRODUCTS

020621 UNTREATED BASE COURSE

The untreated base course shall consist of select material, either natural or crushed and shall be graded as follows:

<u>Sieve Size</u>	<u>Ideal Gradation</u>	<u>Tolerances</u>
1-inch	100	0 %
½- inch	85	± 6 %
No. 4 Sieve	55	± 6 %
No. 16 Sieve	31	± 4 %
No. 200 Sieve	9	± 2 %

020622 TACK COAT

Tack Coat shall be emulsified asphalt Grade SS-1 or SS-1h, CSS-1 or CSS-1h diluted with one part water to one part emulsified asphalt, undiluted asphalt Grade RS-1 or CRS-1, or paving asphalt Grade AR-1000. Emulsified asphalt shall comply with the requirements of AASHTO M 140 (ASTM D 977) or M 208 (ASTM D 2397); paving asphalt shall comply with the requirements of AASHTO M 226 (ASTM D 3381).

020623 ASPHALT CEMENT

Asphalt coat shall be Grade AC-10 or AC-20 complying with the requirements of AASHTO M 226 (ASTM D 3381).

020624 MINERAL AGGREGATE

Mineral aggregate shall be crushed stone, crushed slag, crushed gravel, stone or slag screening, sand, mineral filler, or a combination of two or more of these materials. Coarse and fine aggregate shall comply with all the quality requirements, except soundness, of ASTM D 692 and D 1073, respectively. Coarse aggregate failing to comply with abrasion requirements may be used if experience has demonstrated it to be satisfactory.

Mineral filler shall comply with ASTM D 242

Combinations of aggregates having a history of polishing shall not be used in surface courses.

020625 ASPHALT-AGGREGATE MIXTURES

Bituminous Surface Course Mixtures: The CONTRACTOR shall submit for approval a job-mix formula for each mixture. The job-mix formula for the asphalt-aggregate base course mixture shall be within the following limits.

<u>Sieve Size</u>	<u>Total Percent Passing By Weight</u>
3/4-inch	100
1/2-inch	74 - 99
3/8-inch	69 - 91
No. 4	49 - 65
No. 8	33 - 47
No. 16	21 - 35
No. 50	6 - 18
No. 200	2 - 6

Bituminous Surface Course Mixture Test Criteria: The asphalt-aggregate surface course mixture shall meet the following test criteria based on a blow count of 75.

Stability (Marshall):	1800 lbs
Flow (Marshall Method) (0.01 in):	8 - 14
Air Voids:	4 percent
Voids in Mineral Aggregate:	14 min. percent

020626 SOIL STERILANT

Soil sterilant or chemical weed control agent shall be a commercial product manufactured specifically to sterilize the subgrade soil to prevent the growth of weeds, plants or any type of vegetation. Refer to Section – 020382 Soil Sterilization.

020630 EXECUTION

020631 SUBGRADE PREPARATION

The subgrade shall be prepared in accordance with Section 020300- Earthwork as applicable to roadways and embankments. The surface of the subgrade after compaction shall be hard, uniform, smooth and true to grade and cross-section. Subgrade for pavement shall not vary more than 0.02-foot from the indicated grade and cross section. Subgrade for base material shall not vary more than 0.04-foot from the indicated grade and cross section.

Apply soil sterilant or chemical weed control agent in strict compliance with manufacturer’s dosages and application instructions, and any applicable laws, ordinances or regulations governing the use of such chemicals.

020632 UNTREATED BASE COURSE

Untreated base course shall be provided where indicated to the thickness indicated. Imported untreated bases shall be delivered to the Site as uniform mixtures and each layer shall be spread in one operation. Segregation shall be avoided and the base shall be free of pockets of coarse or fine material. Where the required thickness is 6-inches or less, the base materials may be spread and compacted in two or more layers of approximately equal thickness, and maximum compaction thickness of any one layer shall not exceed 6-inches. The relative compacted surface of the finished base shall be hard, uniform, smooth and at any point shall not vary more than 0.02-foot from the indicated grade or cross-section.

020633 TACK COAT

A tack coat shall be applied to existing paved surfaces where new asphalt concrete is to be placed on existing pavement. It shall also be applied to the contact surface of all cold pavement joints, curbs, gutters, manholes and the like immediately before the adjoining asphalt pavement is placed. Care shall be taken to prevent the application of tack coat materials to surfaces that will not be in contact with the new asphalt concrete pavement. Diluted emulsified asphalt shall be applied at the rate of 0.05 to 0.15 gal/sq-yd. Undiluted emulsified asphalt shall be applied at the rate of 0.025 to 0.075 gal/sq-yd. paving asphalt shall be applied at the rate of approximately 0.05 gal/ sq-yd.

020634 ASPHALT CONCRETE

At the time of delivery to the Site, the temperature of mixture shall be lower than 260 degree Fahrenheit or higher than 320 degrees Fahrenheit, the lower limit to be approached in warm weather and the higher in cold weather.

Asphalt concrete shall not be placed when the atmospheric temperature is below 50 degrees Fahrenheit during unsuitable weather when the base is wet or during other unfavorable weather conditions as determined by the ENGINEER. The air temperature shall be measured in the shade.

The asphalt concrete shall be evenly spread upon the subgrade or base to such a depth that, after rolling, it will be of the required cross section and grade of the course being constructed.

The depositing, distributing, and spreading of the asphalt concrete shall be accomplished in a single, continuous operation by means of a self-propelled mechanical spreading and finishing machine designed specially for that purpose. The machine shall be equipped with a screed or strike-off assembly capable of being accurately regulated and adjusted to distribute a layer of the material to a pre-determined thickness. When paving is of a size or in a location that use of a self-propelled machine is impractical, the ENGINEER may waive the self-propelled requirement.

Spreading, once commenced, shall be continued without interruption.

The mix shall be compacted immediately after placing. Initial rolling with a steel-wheeled tandem roller, steel three-wheeled roller, vibratory roller, or a pneumatic-tired roller shall follow the paver as closely as possible. If needed, intermediate rolling shall eliminate marks from previous rolling. In areas too small for the roller, a vibrating plate compactor or hand tamper shall be used to achieve thorough compaction.

Upon completion the pavement shall be true to grade and cross-section. When a 10-ft straightedge is laid on the finished surface parallel to the center of the roadway, the surface shall not vary from the edge of the straightedge more than 1/8-inch except at intersections or changes of grade. In the transverse direction, the surface shall not vary from the edge of the straightedge more than 1/4-inch.

The relative density after compaction shall be 95 percent of the density obtained by using ASTM D 1188 or D 2726. A properly calibrated nuclear asphalt testing device shall be used in accordance with ASTM D 2922 for determining the field density of compacted asphalt concrete, or slabs or cores may be laboratory tested in accordance with ASTM D 1188.

020635 BITUMINOUS SURFACE PATCHING

Where utility trenches are excavated through bituminous surface roads, driveways, parking areas, etc., the

surface shall be restored and maintained as follows: A temporary gravel surface shall be placed and maintained after the required backfill and compaction of the trench has been accomplished

1. The gravel shall be placed to such depth as to provide six inches below the pavement and shall be brought flush with the paved surface.
2. The area over trenches to be resurfaced shall be graded and rolled with a roller weighing not less than twelve tons, or with the rear wheels of a five-yard truck loaded to capacity, until the subgrade is firm and unyielding. Mud or other soft or spongy materials shall be removed and void filled with gravel and rolled and tamped thoroughly in layers not exceeding six inches in thickness. The edges of trenches which are broken down during the making of subgrade shall be removed and trimmed neatly before resurfacing.
3. Before any permanent resurfacing is placed, the CONTRACTOR shall trim the existing paving to clean, straight lines as nearly parallel to the centerline of the trench as practicable.
4. Existing bituminous paving shall be cut back a minimum of six inches beyond the limits of any excavation of cave-in along the trench so that the edges of the new paving will rest on at least six inches of undisturbed soil.

As soon as is practical, weather permitting, the bituminous surface shall be restored by standard paving practices to the thickness specified herein.

020680 CURBS, GUTTERS, AND SIDEWALKS

The various types of concrete curb, gutter, sidewalk, driveways and alley intersections shall be constructed to the dimensions indicated on the Plans and detail drawings.

020681 MATERIALS

Concrete shall be Class A, conforming to the applicable requirements of DIVISION 3.

020682 CONSTRUCTION METHODS

The subgrade shall be constructed and compacted true to grades and lines indicated on the Plans and as specified hereinbefore. All soft or unsuitable material shall be removed to a depth of not less than 6 inches below subgrade elevation and replaced with satisfactory material.

Concrete curbs, gutters, and sidewalks shall be constructed by the conventional use of forms, or may be constructed by means of a curb and gutter machine if acceptable to the Engineer.

If machines designed specifically for such work and accepted by the Engineer are used, the results must be equal to or better than that produced by the use of forms. If the results are not satisfactory the use of the machines shall be discontinued. All applicable requirements of construction by use of forms shall apply to the use of machines.

Forms conforming to the dimensions of the curb, gutter, sidewalk, driveways, and alley intersection shall be carefully set to line and grade, and securely staked in position. The forms and subgrade shall be watered immediately in advance of placing concrete. Forms shall be thoroughly cleaned each time they are used and shall be coated with a light oil or other releasing agent of a type which will not discolor the concrete.

The concrete shall be thoroughly spaded away from the forms so that there will be no rock pockets next to the forms. The concrete may be compacted by mechanical vibrators accepted by the Engineer. Tamping or vibrating shall continue until the mortar flushes to the surface and the coarse aggregate is below the concrete surface.

The front face form shall not be removed before the concrete has taken the initial set and has sufficient strength to carry its own weight. Gutter forms and rear forms shall not be removed until concrete has hardened sufficiently to prevent damage to the edges. Special care shall be taken to prevent any damage. Any portion of concrete damaged while stripping forms shall be repaired or, if the damage is severe, replaced at no additional cost to the Owner. The face, top, back, and flow line of the curb and gutter shall be tested with a 10-foot straightedge or curve template longitudinally along the surface. Any deviation in excess of 1/4-inch shall be corrected at no additional cost to the Owner.

Any sections of the work deficient in depth or not conforming to the Plans or Specifications shall be removed and replaced by the Contractor at no additional cost to the Owner.

Finishing and curing of the concrete shall be done in the manner specified in DIVISION 3.

When required by the Engineer, where gutters have a slope of 0.8-foot per hundred feet or less, or where unusual or special conditions cast doubt on the capability of the gutters to drain, they shall be water tested. Water testing shall consist of establishing flow in the length of gutter to be tested by supplying water from a hydrant, tank truck, or other source. One hour after the supply of water is shut off, the gutter shall be inspected for evidence of ponding or improper shape. In the event water is found ponded in the gutter to a depth greater than 1/2-inch, or on the adjacent asphalt pavement, the defect or defects shall be corrected in a manner acceptable to the Engineer without additional cost to the Owner.

020683 EXPANSION AND CONTRACTION JOINTS

Expansion joints shall be constructed vertical, and at right angles to the centerline of the street and shall match joints in adjacent pavement or sidewalks. Joints shall be constructed at all radius points, driveways, alley entrances, and at adjoining structures. Expansion joint filler shall comply with the requirements of the material as specified in DIVISION 3.

Contraction joints shall be constructed not more than 15 feet apart. Joints shall be made by the use of steel dividers scoring or saw cutting to a depth of not less than 1-1/2 inches and shall match joints in adjacent pavement or sidewalk.

020684 BACKFILLING

Unless otherwise specified the Contractor shall backfill behind the curbs or sidewalk with soil native to the area to the lines and grades indicated on the Plans.

020700 SITE IMPROVEMENTS

This section includes all surface improvements to the site other than pavement, curb, gutter, and sidewalk and those pertaining to the functional operation of the facility. This includes fences, masonry walls and screens, information and traffic control facilities, guards and guard rails, irrigation systems, and other similar improvements.

020900 SPRINKLER SYSTEM

Sprinkler system shall be constructed to the sizes, grades, and locations indicated on the Plans. Sprinkler lines indicated on the Plans are essentially diagrammatic. Locations of all sprinkler heads, shrub heads, etc., shall be established by the Contractor at the time of construction. Typical spacings of the sprinkler heads are indicated on the Plans and shall not be exceeded.

Unless otherwise specified, the construction of sprinkler systems shall include the furnishing; installing; and testing of mains, laterals, risers, and fittings; the furnishing and installing of sprinkler heads, gate valves, control valves, automatic valves, and automatic controllers; the removal and/or restoration of existing improvements; excavation and backfill; and all other work in accordance with the Plans and Specifications.

EXAMINATION AND VERIFICATION OF DRAWINGS AND SITE: It shall be the contracting installer's responsibility to report to the Engineer any deviations between mechanical drawings, Specifications, and the site. Failure to do so prior to the installing of equipment, resulting in replacing and/or relocating equipment, shall be done at the Contractor's expense.

020901 ORDINANCES AND REGULATIONS

All local, municipal, and state laws, rules, and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these Specifications and their provisions shall be carried out by the sprinkler contractor. Anything contained in these Specifications shall not be construed to conflict with any of the above rules and regulations or requirements of same. However, when these Specifications and/or drawings call for or describe materials, workmanship, or construction of a better quality, higher standard, or larger size, Specifications and/or drawings shall take precedence over the requirements of said rules and regulations.

020902 MATERIALS

Whenever any material is specified by name and/or number thereof, such Specifications shall be deemed to be used for the purpose of facilitating a description of the materials and establishing quality, and shall be deemed and construed to be followed by the words "or equal". All materials shall be new and the best of their class and kind. Sufficient descriptive literature and/or the best of their class and kind. Sufficient descriptive literature and/or samples must be furnished for any materials submitted as "equal" substitutes.

All materials shall be guaranteed for a period of one year against material defects and workmanship.

020903 PRECEDENCE OF DRAWINGS

All specific notes indicated on the drawings regarding the sprinkler system shall take precedence over these Specifications. All work designated on the Plans by notes shall be furnished and installed, whether or not specifically mentioned in these Specifications. The drawings for the sprinkler system shall take precedence over these Specifications.

It shall be the Contractor's responsibility to notify the Engineer of any discrepancy or change between the Plans and actual site.

020904 RECORD DRAWINGS

Immediately upon installation of any piping, valves, or sprinkler head, in locations other than indicated, the Contractor shall clearly indicate such changes on Plan sets. After final acceptance of the project, these shall be turned over to the Engineer for record purposes.

020910 EXCAVATION AND BACKFILL

Trenches for plastic pipe sprinkler lines shall be excavated either by hand or machine and shall be of sufficient width to permit proper handling and installation of the pipe and fittings. The backfill shall be thoroughly compacted and evened off with the adjacent soil level. Selected fill dirt or sand shall be used if soil conditions are rocky. Trenching depth shall be 2 inches below normal trench depth to allow for this bedding. The fill dirt or sand shall be used in filling 4 inches above the pipe. The remainder of the backfill shall contain no lumps or rocks larger than 3 inches. The top 6 inches of backfill shall be free of rocks over 1 inch, subsoil, and trash. It is recommended that backfill be made first thing in the morning while pipe and soil temperatures are approximately the same.

020911 PIPE AND TUBES

Unless otherwise specified, the construction of sprinkler lines and control lines shall include excavation and backfill; the furnishing, installing, and testing of sprinkler pipe, tube, and fittings; and the removal and/or restoration of existing improvements and all other work in accordance with the Plans and Specifications.

Unless otherwise indicated on the Plans, all plastic lateral pipe sprinkler lines shall be installed with a minimum cover of 12 inches based on finished grades. Sprinkler main lines shall be installed with a minimum cover of 18 inches based on finished grades.

All piping and tubing under walks and pavement shall be in PVC, Schedule 40 sleeves (size as required).

Generally, piping under concrete shall be installed by jacking, boring, or hydraulic driving. Where any cutting or breaking of sidewalks and/or concrete work is necessary, it shall be removed and replaced by the Contractor. Permission to cut or break sidewalks and/or concrete shall be obtained from those having proper jurisdiction. Where piping on the Plans is indicated under paved areas but running parallel and adjacent to planted areas, the intent of the Plans is to install the piping in the planted areas.

020911.10 PLASTIC PIPELINES

Plastic pipe shall be unplasticized PVC Schedule 40 for all pressure and nonpressure lines, extruded from virgin parent materials of the type specified on the Plans. The pipe shall be homogenous throughout, free from visible cracks, holes, foreign materials, blisters, deleterious wrinkles, and dents. Pipe shall conform to the requirements of PVC pipe and fittings in DIVISION 15.

020911.12 PLASTIC PIPE FITTINGS AND CONNECTIONS

The plastic pipe and fittings to be installed shall be Schedule 40 molded fittings manufactured of the same material as the pipe and shall be suitable for either solvent weld or screwed connections. No fittings made of other materials shall be used. Do not use compression fittings in the lines.

Slip fittings socket taper shall be so sized that a dry unsoftened pipe end, conforming to these Specifications, can be inserted no more than halfway into the socket. Plastic saddle and flange fittings will not be permitted. Only Schedule 80 pipe may be threaded.

When the connection is plastic to metal, male adapters shall be used. The male adapter shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be Permatex Type II, Keytite No. 4586J1, or equal.

020911.13 DELIVERY

Plastic pipe, fittings, and connectors shall be delivered to the site in unbroken bundles or rolls, packaged in such a manner as to provide adequate protection for the pipe ends, threaded or plain. All pipes, fittings, and connections shall be covered so as to protect them from exposure to sunlight.

020911.14 INSTALLATION OF PLASTIC PIPE

Plastic pipe shall be installed in a manner so as to provide for expansion and contraction as recommended by the manufacturer.

Plastic pipe shall be cut with a hand saw or hack saw with the assistance of a squared-in sawing vise, or in a manner so as to ensure a square cut. Burrs at cut ends shall be removed prior to installation so that a smooth unobstructed flow will be obtained.

All plastic to plastic joints shall be solvent weld joints. Only the solvent recommended by the manufacturer shall be used. Both a primer and solvent shall be used in accordance with manufacturer=s printed instructions.

All plastic to metal joints shall be made with plastic male adapters or PVC Schedule 80 nipples.

The solvent weld joints shall be made in the following manner:

- A. Thoroughly clean the mating pipe and fitting with a clean dry cloth.
- B. Apply primer to pipe and fittings.
- C. Apply a uniform coat of solvent to the outside of the pipe with a nonsynthetic bristle brush.
- D. Apply solvent to the fitting in a similar manner.

- E. Reapply a light coat of solvent to the pipe and quickly insert it into the fitting.
- F. Give the pipe or fitting a quarter turn to ensure even distribution of the solvent and make sure the pipe is inserted to the full depth of the fitting socket.
- G. Hold in position for 15 seconds for 1-inch and less in diameter. For pipe sizes larger than 1 inch in diameter the manufacturers written instructions shall be followed.
- H. Wipe off excess solvent that appears at the outer shoulder of the fittings.

Care shall be taken so as not to use an excess amount of solvent, thereby causing a burr or obstruction to form on the inside of the pipe.

The joints shall be allowed to set at least 24 hours before pressure is applied.

020911.15 FLUSHING AND TESTING

After all new sprinkler piping and risers are in place and connected, and all necessary division work has been completed, and prior to the installation of sprinkler heads, control valves shall be opened and a full head of water used to flush out the system. After the system is thoroughly flushed, risers shall be capped off and the system pressure tested.

Sprinkler lines less than 2-1/2 inches in diameter shall be tested and placed before backfilling for a period of not less than 1 hour, and shall show no leakage or loss of pressure. During the test period, minimum test pressure at the highest point of the section being tested shall be 100 psi.

020912.20 POP-UP ROTARY HEAD FULL AND PART CIRCLE

The sprinkler shall be capable of covering 38 feet radius at 35 psi with a discharge rate of 4.3 gpm for full circle heads. The part circle head shall be capable of covering 38 feet radius at 35 psi with a discharge rate of 3.0 gpm; the inlet shall be 3/4-inch IPS thread, 6-1/8-inch height, with a large basket filter area serviceable through top of sprinkler, the drive mechanism shall be gear driven with grease packed gear assembly isolated from water stream. The head shall be made of cycolac plastic with pop-up stroke of 2-3/8 inches with positive spring retraction. Part circle heads shall be adjustable in arcs from 45 degrees to 315 degrees in 1-degree increments.

020912.30 STATIONARY POP-UP SPRINKLER HEADS

The sprinkler heads shall be of cycolac plastic construction 2-inch IPS female pipe connection. Head shall have 4-inch pop-up stroke and positive retraction spring with basket screening easily serviced through top of sprinkler. The head shall be capable of covering the radius with gpm and psi as indicated on the Plans.

020912.40 BUBBLER HEADS

All heads shall be made of cycolac plastic with 2-inch IPS female connection and shall be fully adjustable for gallonage by a tool and adjusting screw not to be removable, and psi as indicated on the Plans. The head shall also have serviceable screens.

020912.50 DRAINS

Manual valves & boxes shall be installed at all low points to facilitate drainage of the system. The locations shall be determined by the Contractor and Engineer or as shown on the plans at the time of placement. A one cubic foot drainage sump of 3/4-inch crushed rock shall be placed under each drain.

020913 VALVES

Unless otherwise specified, the installation of valves shall include excavation and backfill; and furnishing, installing, and testing of risers, fittings, and valves; the removal and/or restoration of existing improvements; and all other work in accordance with the Plans and Specifications.

020913.10 REMOTE CONTROL VALVES, THERMAL HYDRAULIC TYPE

The electric valve shall be of the globe type, integrally molded single seat diaphragm, operated and actuated by a 24-volt electric solenoid. Body and top cover shall be all plastic. It shall contain a manually operated adjustable stem enabling the valve to be partially or fully closed unless otherwise designated on the Plans. Valves shall be installed according to manufacturer=s recommendation. Valves shall be Model 100 PE by Rainbird or equal.

020915 AUTOMATIC CONTROLLER

The irrigation system controller shall be an electro-mechanical type, capable of fully automatic or manual operation of the system. It shall be housed in a wall/pedestal mountable heavy-duty, key-lock cabinet. The controller shall be weatherproof for outdoor installation.

The controller shall operate on a minimum of 117 VAC, 50 Hz, and shall be capable of operating a total of four 24 VAC solenoid valves per station. The controller shall have a reset circuit breaker to protect if from power overload.

The controller shall have 12 stations with time setting knobs capable of omitting the station from an irrigation cycle, or being set for incrementally variable timing from 3 to 60 minutes per station, in 1 minute increments.

The controller shall have a 14-day calendar dial with captive pins for setting the program start days, and a 24-hour clock dial with 23 captive hour pins for programming 1 to 23 automatic start times per day. A master On-off@ switch shall permit system shutdown for rainy weather or system maintenance, while retaining the program.

The controller shall have available an optional 15-day programmable calendar dial kit using captive pins. The 15-day dial shall permit irrigation once every 3 days or once every five days, in addition to any day within a 15 day range.

The controller shall be Model ESP-12LX as manufactured by Rain Bird Sprinkler Mfg. Corp. Glendora, California, or equal.

020916 IRRIGATION CONTROL CABLE

All wiring to be used for connecting the automatic controller to the electric thermal hydraulic remote control valve shall be Type UF-600V, 7-strand or solid copper, PVC insulation, single conductor, UL approved underground feeder cable. All pilot or Ahot@ wires shall be of one color and all Acommon@ wires shall be of another color.

020916.10 WIRE CONNECTORS

All splices shall be connected with the pen-tite type wire connector and installed according to manufacturer=s recommendations. Connectors shall be used for both 24-volt wiring and 120-volt in the field. All wiring shall be spliced in a pull box.

020917 CLOSING IN UNINSPECTED WORK

The Contractor shall not allow nor cause any of his work to be covered or enclosed until it has been inspected, tested, and accepted by the Engineer. Should any of his work be enclosed or covered before such inspection and test, he shall uncover the work at his own expense and after it has been inspected, tested, and accepted shall make all repairs with like materials necessary to restore all his work and that of other contractors to its original condition, at no additional cost to the Owner.

021000 LANDSCAPE WORK

All tools, equipment, materials and labor shall be provided to as required to carry out planting operation. No error or discrepancy in the Plans or Specifications shall cause defective or inappropriate materials to be used or poor workmanship to be allowed. Work must be carried out only during weather conditions favorable to landscape construction and to health and welfare of plants. Contractor responsible for the first application of a broad leaf herbicide to eliminate weeds that have grown with the lawn.

All areas affected by construction shall be revegetated with an upland non-irrigated native grass seed mix with wild flowers as shown on the Plans. Revegetation on slopes steeper than 3 horizontal to 1 vertical shall be supported by erosion control blankets as specified below.

021010 REVEGETATION

Work includes the furnishing of all labor, material, equipment, and services necessary to complete work for this Section as indicated on the Plans and as specified.

All areas affected by construction shall be revegetated with an upland non-irrigated seed mix with wild flowers as specified below and shown on the plans. Revegitation on slopes steeper than 3 horizontal to 1 vertical shall be supported by erosion control blankets as specified below.

021010.10 MATERIALS

021010.11 SEEDS

All seed shall be from tested lots and shall be delivered to the site of the Work in standard containers labeled as required by State of Utah and U.S. Department of Agriculture regulations. Labels shall show the variety of strain of seed, degree of purity (percent), rate of germination (percent), weed content (percent), and date of test. The kind of seed planted shall be appropriate for the planting season, and shall be one of the following. Seeds shall be 100 percent pure live seed. Seed shall be planted and germinated

before the project completion date.

021010.50 SUBSTITUTIONS

Plants of kinds other than those indicated on the plant list will be considered by the Engineer only upon submission of proof that any plant is not reasonably procurable in the local region and upon prior authorization by essential characteristics as the kind of plant specified in regard to appearance, ultimate height, shape, habit of growth, general soil, and other requirements. In no case shall the average cost and value of the substituted plants be less than the cost and value of plants indicated.

All substitutions must be submitted in writing at least seven days prior to bid opening date and acceptance of the substitution must be acknowledged by the Engineer in writing.

021011 SOIL PREPARATION

Native topsoil stripped and stored separately at the beginning of the project shall be reused as topsoil. The soil shall not be worked when the moisture content is so great that excess compaction will occur, nor when it is so dry that a dust will form in the air or that clods will not break readily. Water shall be applied if necessary to provide ideal moisture content for planting.

Uniformly till soil to a depth of 6 inches by dragging, disking, or other approved method prior to raking. Rake all seed areas, removing all clods or rocks 1 1/2 inch in diameter and larger.

In all final preparations for seeding, a level board not less than 8 feet in length shall be used to ensure true and accurate grades. Finish grade of lawn areas shall be 2 inches below elevation of adjacent paving.

After areas have been prepared for seeding, no heavy objects except lawn rollers shall be taken over these areas at any time. Prior to seeding, the Engineer shall accept these areas for grade and compaction.

021012 PRODUCTS

021012.10 FERTILIZER

Fertilizer shall be 0 percent nitrogen, 20 percent phosphorus, and 20 percent potassium. Deliver fertilizer, mixed as specified, in original unopened standard size bags showing weight, analysis and name of manufacturer. Store fertilizer in such manner that it shall be kept dry.

021012.11 HUMUS

Humus shall be decomposed stabilized fortified, treated (nitrolized) wood products with no more than 1 % nitrogen after treatment: fir mulch, pine mulch, or redwood mulch.

021012.12 TOPSOIL

Top soil shall be natural, friable, fertile, fine loamy soil possessing characteristics of representative topsoil in the vicinity that produces heavy growth. It shall have a pH range of 5.5 to 7, 4% minimum organic material, and free from any materials which may be harmful to plant growth or hinder planting operations. It shall be supplied from naturally well-drained sites; do not obtain top soil from bogs or marshes.

021012.13 MANURE

Manure shall be well-rotted, unleached stable or cattle manure, reasonably free from shavings, sawdust, or refuse, and shall contain no more than 10 percent straw. Manure shall be odorless.

021012.14 PREPARED BACKFILL

Prepared backfill shall be composed of two parts of native soils to one part of a humus by volume and the fertilizer 0-20-20 to be added at a rate of 1-½ pounds per cubic yard.

021012.17 WATER

Water used in planting shall be kept free from oil, acids, alkali, salt, and other substances harmful to plant growth. Potable, on-site water shall be furnished by Owner. Contractor shall furnish hose and other watering equipment.

021012.18 BARK/TREE MULCH

Mulch shall be evenly spread in planting areas indicated on the Plans. It shall be of sufficient character as to not be easily displaced by wind or water runoff.

021012.19 WEED CONTROL FABRIC

A fabric weed cloth shall be placed under all areas to receive bark chips, landscape rock, or as otherwise shown on the Plans. Use anchoring pins to secure the edges and seams and overlap the edges 6" or as recommended by the manufacturer. The cloth shall be placed tightly against the placed potted trees and shrubs. The cloth shall be DeWitt Pro-5 Weed Barrier, or equal.

021012.21 EROSION CONTROL FABRIC

Erosion control fabric shall be provided on slopes steeper than 1V:3H. SuperGro 4868 Erosion Control Fabric as manufactured by Amoco Fabrics or equal shall be provided and installed according to the manufacturer’s directions. The areas to be covered by erosion control blankets shall be properly prepared, fertilized and seeded before blanket is applied. On slopes, apply blankets vertically (length-wise) on slope, overlapping edges a minimum of 12-inches. A 6-inch deep by 12-inch wide anchor trench shall be provided at the crest and toe of all slopes to anchor the blanket. Erosion control fabric shall have the following properties:

<u>Property</u>	<u>Typical Value</u>
Weight	0.7 oz/yd ²
Specific Gravity	0.9
Max. Shear Stress	> 6 lb/ft ²
UV Degradable Net	Yes
Fire Retardant	Meets Flammability Test CS191-53
Color	Turf Green

021020 EXECUTION

021021 EXCAVATION FOR PLANTING

Excavation for planting shall include the stripping and stockpiling of all acceptable top soil encountered within the areas to be excavated for tree and shrub pits, and ground cover beds. The Contractor shall be responsible for fine grading of planting areas.

021022 SOIL PREPARATION

The planting of trees and seed mix shall be performed during favorable weather conditions, during the season or seasons which are normal for such work, as determined by acceptable local practice. The soil shall not be worked when the moisture content is so great that excess compaction will occur, nor when it is so dry that a dust will form in the air or that clods will not break readily. Water shall be applied if necessary to provide ideal moisture content for planting.

Any rock or other underground obstructions shall be removed, if possible, to the depth necessary to permit proper planting, according to the Plans and Specifications. If underground constructions, obstructions, or rocks are encountered in the excavation of planting areas, other locations for the planting may be selected by the Contractor only upon acceptance of the Engineer. Prior to any work, the Contractor shall be knowledgeable of the locations of all existing underground installations, and their protection shall be his responsibility. All damage shall be corrected at the expense of the Contractor.

Where subsoils are unsuitable for planting due to excessive compaction, the soil shall be loosened with spikes, discing, or other means to a minimum of 12 inches with additional loosening as required to obtain adequate drainage. The Contractor may introduce peat moss, sand, or organic matter into the subsoil to obtain adequate drainage. Such remedial measure shall be considered as incidental, without additional cost to the Owner. Any construction materials, debris, or objectionable material shall be removed from the planting areas.

Uniformly till soil to a depth of 6 inches by dragging, disking, or other approved method prior to raking. Rake all seed areas, removing all clods or rocks 1 1/2 inch in diameter and larger. Two inches of top soil shall be placed over lawn and bed areas. Place topsoil so that after final settlement there will be positive drainage conforming to elevations shown on the Plans.

021023 PLANTING OF TREES, SHRUBS, AND GROUND COVER

021023.40 FERTILIZATION

Grass or sodden areas shall have fertilizer applied in two applications with a thorough watering following each application. The first application shall be one week prior to seeding/sodding at the rate of 25 pounds per 1000 square feet and barrowed into the top two inches of topsoil. The second application shall be at the rate of 10 pounds per 1000 square feet immediately following the second mowing.

021030 PROTECTION

Use precautionary measure when performing work around trees, sidewalks, pavements, utilities and other feature either existing or previously installed. In order to avoid damage to roots, bark, or lower branches, no truck or other equipment shall be driven or parked within drip line of any tree. Plants shall be kept moist, fresh, and protected. Such protection shall encompass entire period during which plants are in transit,

being handled, or are in temporary storage.

Plants too large for two people to lift shall be placed with a sling. Do not rock trees in holes to raise. Holes for trees shall be at least 2 feet greater in diameter than spread of root system and at least 6 inches deeper than root ball. Holes for shrubs and vines shall be at least 12 inches greater in diameter than spread of root system and at least 2 feet deep.

Protect seeded areas from pedestrian or vehicular trespassing while grass is germinating. Furnish and install fences, signs, barriers, or other necessary temporary protective devices. Contractor shall repair damage resulting from trespass, erosion, washout, settlement, or other causes at his expense.

021040 GROUND MAINTENANCE DURING CONSTRUCTION

The Contractor shall begin maintenance immediately after planting. Plants shall be watered, mulched, weeded, pruned, sprayed, fertilized, cultivated, and otherwise maintained and protected until acceptance. Settled plants shall be reset to proper grade and position, and dead material removed and replaced. Maintain all landscaped areas on a continuous basis as they are completed during the course of work and until final acceptance of the work. Maintenance shall include keeping the landscape areas free of debris and weeding and cultivating the planted areas at intervals acceptable to the Engineer. The Contractor shall provide adequate personnel to accomplish the required maintenance.

The Contractor shall ensure that all plant materials are in a sound, healthy, vigorous condition free from insects, bark abrasions, weak branches, or other objectionable disfigurements and shall immediately replace any plant which is unacceptable to the Engineer at any time up to and including final acceptance of the Work by the Owner.

021050 PLANT MATERIAL AND GROUND MAINTENANCE PERIOD

021051 DESCRIPTION

This work shall include watering, weeding, lawn mowing, clipping, pickup and disposal, lawn edging, and general care of all plant material to produce vigorous healthy growth. All granite and rock areas shall be cleaned of all debris and maintained in a clean condition throughout the maintenance period.

Maintenance period shall be performed for a period of 60 calendar days after acceptance of the entire project by the Owner.

021052 GUARANTEE

During the maintenance period all plants shall be guaranteed to remain in a healthy vigorous state of growth. At any time, up to and including the end of the maintenance period, plants found not acceptable to the Engineer shall be replaced and guaranteed for an additional period of 60 calendar days. The 60-day guarantee period shall remain in effect on all plant replacements regardless of time and replacement and will apply to all replacements until they are successfully established for a 60-day period.

*** END OF DIVISION 2 ***

DIVISION 3

CONCRETE

030000 GENERAL

Except as otherwise specified, concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, and water so proportioned and mixed as to produce a plastic, workable mixture in accordance with all requirements of these Specifications and suitable to the specific conditions of placement. The proportions of materials shall be such as to secure the lowest water-cement ratio which is consistent with good workability, a plastic, cohesive mixture, and one which is within the specified slump range. The proportion of fine and coarse aggregate shall be such as not to produce harshness in placing nor honeycombing in the structures.

030001 WATERTIGHTNESS OF CONCRETE WORK

It is the intent of this Specification to secure for every part of the Work concrete and grout of homogeneous structure, which when hardened will have the required strength, water tightness, and resistance to weathering.

It is recognized that some surface hairline cracks and crazing will develop in the concrete surfaces. Construction, contraction, and expansion joints have been positioned in structures, and curing methods specified, for the purpose of reducing the number and size of these expected cracks, due to the normal expansion and contraction expected from the specified concrete mixes. Class A and Class B concrete shall be watertight. Cracks which develop in walls or slabs shall be repaired. Cracks which show any signs of leakage shall be repaired until all leakage is stopped.

Visible cracks, other than hairline cracks and crazing, in the following areas shall be pressure grouted with low viscosity epoxy as specified herein as Epoxy Injection System: floors and walls of water bearing structures; walls and overhead slabs of passageways or occupied spaces, the outside of which are exposed to weather or may be washed down and are not specified to receive a separate waterproof membrane; slabs over water channels, wet wells, reservoirs, and other similar surfaces not specified to receive a separate waterproof membrane.

Walls or slabs, as above, that leak or sweat because of porosity or cracks too small for successful pressure grouting, shall be sealed on the water or weather side by coatings of a surface sealant system, as specified elsewhere herein.

Grouting or sealing as specified above shall be continued until the structure is watertight and shall remain watertight for not less than one year after final acceptance or date of final repair, whichever occurs later in time.

030002 JOINTS AND BONDING

As far as practicable the concrete work shall be constructed as a monolith. The locations of contraction, construction, and other joints are indicated on the Plans or specified herein. Where not specified or indicated otherwise, all slabs and walls shall have construction joints at intervals not greater than 30 feet. In order preserve the strength and water tightness of the structures, no other joints shall be made except as the Engineer may authorize. At construction joints, the concrete in place shall be thoroughly cleaned of laitance, grease, oil, mud, dirt, curing compounds, mortar droppings, or other objectionable matter by means of a bush hammer or heavy sandblasting, after which the surfaces shall be washed just prior to the

succeeding concrete placement. Immediately prior to resuming concrete placing operations, a bed of grout not less than ½ inch in thickness nor more than 1 inch in thickness shall be thoroughly spread over the horizontal joint surfaces. Keyways in joints shall be provided as indicated on the Plans. Material for keyways shall be steel, plastic or lumber treated with form release coating, applied in accordance with the manufacturer's published instructions.

Construction joints shall be washed free of sawdust, chips, and other debris after forms are built and immediately before the concrete placement. Should formwork confine sawdust, chips, or other loose matter in such manner that it is impossible to remove them by flushing with water, a vacuum cleaner shall be used for their removal, after which the cleaned surfaces shall be flushed with water. A cleanout hole shall be provided at the base of each wall and column for inspection and cleaning.

In any case where it is necessary to repair concrete by bonding mortar or new concrete to concrete which has reached its initial set, the surface of the set concrete shall first be coated with epoxy bonding agent Concessive No. 1001 LPL as manufactured by Adhesive Engineering; Sikadur Hi-Mod as manufactured by Sika Chemical Corporation; or equal. This material shall be applied in accordance with the manufacturer's published instructions. Bonding agent will not be required for filling form tie holes or for normal finishing and patching of similar sized small defects.

Expansion, contraction, and construction joints shall be constructed where and as indicated on the Plans. Waterstops, expansion joint material, synthetic rubber sealing compound, and other similar materials, shall be as specified elsewhere herein.

The Contractor shall schedule the placing of concrete in such a manner as to complete any single placing operation to a construction, contraction, or expansion joint. Special care shall be taken to insure that concrete is well consolidated around and against waterstops and that waterstops are secured in the proper position.

030100 WORKMANSHIP AND METHODS

Concrete work, including detailing of reinforcing, shall be in accordance with the best standard practices and as set forth in the ACI Building Code, Manuals, and Recommended Practices.

All concrete materials shall be so delivered, stored, and handled as to prevent damage to the materials and the inclusion of foreign substances. Packaged materials shall be delivered and stored in original containers until ready for use. Material containers or materials showing evidence of water or other damage shall be rejected.

030101 MEASUREMENTS OF MATERIALS

Materials shall be measured by weighing, except as otherwise specified or where other methods are specifically authorized in writing by the Engineer. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. Cement shall be weighed separately. The accuracy of all weighing devices shall be such that successive quantities of the individual item can be measured to within 1 percent of the desired amount of that item. Cement in unbroken standard packages (sack) need not be weighed, but bulk cement and fractional packages shall be weighed. The mixing water shall be measured by volume or by weight. The water measuring device shall be capable of control of water quantities to an accuracy of 1 percent of the desired amount. All measuring or weighing devices shall be subject to review and acceptance by the Engineer, and shall bear a valid seal of the Sealer of Weights and Measures having jurisdiction.

030102 CONCRETE PROPORTIONS AND CONSISTENCY

The concrete shall be of such consistency and composition that it can be worked readily into the corners and angles of the forms and around the reinforcement without excessive vibration and without permitting the materials to segregate or free water to collect on the surface.

The ratio of coarse aggregate to fine aggregate shall be not less than 1.0 nor more than 2.0 for all concrete with the exception of Class CE.

To avoid unnecessary or haphazard changes in consistency, the aggregate shall be obtained from a source which will ensure uniform quality, moisture content, and grading during any single day's operation. Aggregate shall be delivered to the Work and handled in such a manner that variations in moisture content will not interfere with the steady production of concrete of the specified degree of uniformity and slump.

See Table A of this Division for the concrete mix water to cement ratio, minimum cement content, and slump range.

It is the Contractor's responsibility to control and adjust the concrete batch weights so as to secure the maximum yield, yet at all times the Contractor shall maintain the proportions of the concrete mix within the specified limits.

If it is required, in the opinion of the Engineer, the mixture shall be modified within the limits set forth in these Specifications.

030103 CONCRETE MIXES

Prior to placement of concrete the Contractor shall submit to the Engineer for review and acceptance full details, including mix design calculations for the concrete mix he proposes to use for each class of concrete. After acceptance, the Contractor shall have trial batches of the accepted Class A, Class B, and Class D concrete mix designs prepared by a testing laboratory acceptable to the Engineer. The trial batches shall be prepared using the specified cement and aggregates proposed to be used for the project which conform to these Specifications. The trial batch shall be of sufficient quantity to determine slump, workability, consistency and finishing characteristics, and to provide sufficient 6-inch by 12-inch test cylinders prepared in accordance with ASTM C 31 for the following tests.

Eight test cylinders shall be compression tested in accordance with ASTM C 39, four at 7 days and four at 28 days. A ratio between 7-day and 28-day strength will be established for the mix and the 7-day strength may be taken as a satisfactory indication of the 28-day strength provided the effects on the concrete of temperature and humidity between the seventh and 28-day are taken into account.

Full information shall be submitted for each of the cylinders as to the mix and slump as determined in accordance with ASTM C 143.

If the trial batch tests do not meet the project specifications for slump, strength, workability, consistency, and finishing, the concrete mix design proportions and, if necessary, source of aggregate shall be changed and additional trial batches and tests shall be made until an acceptable trial batch is produced that meets the project specifications.

Test batches and tests required to establish trial batches and acceptability of materials shall be paid for by the Contractor.

After acceptance, the mixes shall not at any time be changed without reacceptance by the Engineer, except that at all times the batching of water shall be adjusted to compensate for the free moisture content of the fine aggregate. The total water content of each of the type concretes shall not exceed those listed in Table A of this Division. Satisfactory means shall be provided at the batching plant for checking the moisture content of the fine aggregate. The details of concrete mixes submitted for review shall include information on the correction of the batching for varying moisture contents of the fine aggregate.

If there is a change in the aggregate source, or if there is a change in aggregate quality from the same source, the Contractor shall submit to the Engineer for review and acceptance a new set of design mixes covering each class of concrete, and a new trial batch and test program shall be undertaken as hereinbefore specified. Each new trial batch and test program shall be at the expense of the Contractor.

030104 TESTING OF CONCRETE

During the progress of construction, the Owner will have tests made to determine whether the concrete, as being produced, complies with the standards of quality specified herein. These tests shall be made in accordance with ASTM C 31, ASTM C 39, and ASTM C 172. Test cylinders will be made and delivered to the laboratory by the Engineer and the testing expense will be borne by the Owner.

Not less than three-cylinder specimens, 6-inch by 12-inch, will be tested for each 150 cubic yards of each grade of concrete with a minimum of three specimens for each grade placed and not less than three specimens for each half day's placement. One cylinder will be broken at 7 days and two at 28 days.

The Contractor shall test the slump of concrete using a slump cone in accordance with the requirements of ASTM C 143. The Contractor shall provide the test equipment. Concrete that does not meet the Specification requirements as to slump shall not be used but shall be removed from the job. The Contractor shall test the slump at the beginning of each placement, as often as necessary to keep the slump within the specified range, and when requested to do so by the Engineer.

The Contractor shall make provisions for and furnish all concrete for the test specimens, and provide manual assistance to the Engineer in preparing said specimens. The Contractor shall be responsible for the care of and providing curing conditions for the test specimens in accordance with ASTM C 31.

030105 ENFORCEMENT OF STRENGTH REQUIREMENT

Concrete is expected to reach a higher compressive strength than that which is indicated in Table A as compressive strength. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the required strength and no individual strength test falls below the required strength by more than 500 psi. Where an individual strength test falls below the required strength by more than 500 psi, the Engineer shall have the right to ask for additional curing of the affected portion followed by cores taken in accordance with ASTM C 42 and ACI 318, all at the Contractor's expense. If the additional curing does not bring the average of three cores taken in the affected area to at least the strength specified, the Engineer may require strengthening of the affected portions of the structures by means of additional concrete or steel or he may require replacement of these affected portions, all at the Contractor's expense.

030110 CLASSES OF CONCRETE

Table A. Concrete Class and Requirements							
Class	Coarse Aggregate Size (inches)	Maximum Water/Cement	Minimum Cement Content (Sacks/C. Y.)	Slump (inches)	Air Content (Percent)	Mix Design Compressive Strength (PSI)	28 Day Minimum Compressive Strength (PSI)
		Max Ratio (lb. /lb.)					
S3 or S3(AE)	1" to No. 4	0.45	7.0	1-3.5	5.0-7.5	6520	5000
S2 or S2(AE)	1" to No. 4	0.45	6.5	1-3.5	5.0-7.5	5870	4500
AA(AE)	2" to No. 4	0.44	6.0	1-3.5	5.0-7.5	5210	4000
	1 1/2" to No.4	0.44	6.0	1-3.5	5.0-7.5	5210	4000
	1" to No. 4	0.44	6.5	1-3.5	5.0-7.5	5210	4000
	3/4" to No. 4	0.44	6.5	1-3.5	5.0-7.5	5210	4000
A or A(AE)	1 1/2" to No. 4	0.45	5.0	1-3.5	4.5-7.5	3910	3000
	1" to No. 4	0.45	5.0	1-3.5	4.5-7.5	3910	3000
	3/4" to No. 4	0.45	5.25	1-3.5	4.5-7.5	3910	3000
B or B(AE)		0.62	4.0	2-5	3.0-6.0	3260	2500
C or C(AE)		0.71	4.0	2-5	3.0-6.0	2610	2000

(AE) = Air-Entrainment

Concrete shall be of five classes, herein referred to as Classes A, B, C, D, and CE which shall be as specified herein and which shall be used in the respective places called for in these Specifications. These classes of concrete shall have a minimum weight of 140 pounds per cubic foot. Class C concrete may be used for fill for unauthorized excavation, for thrust blocks and ground anchors for piping, for bedding of pipe, and when noted on the Plans. Class B concrete may be used where Class A concrete is required, if high-early-strength is desired, at the Contractor's option. Class D concrete shall be used for precast

concrete items. Class CE shall be used for electrical conduit encasements. All other concrete, unless specified or noted otherwise, shall be Class A concrete.

Any concrete that is pumped shall meet all the requirements of these Specifications. In no case shall concrete be placed which shows a slump outside the limits indicated in the table.

Classes A, C, D, and CE concrete shall be made with Type II low alkali. Class B concrete shall be made with Type III low alkali cement. See Admixtures for allowable admixtures.

030120 AGGREGATE

All concrete aggregates shall be sound, uniformly graded, and free of deleterious material in excess of the allowable amounts specified.

The Contractor shall furnish the Engineer certified copies in triplicate of commercial laboratory tests of all samples of concrete aggregates submitted. Tests on concrete aggregates shall indicate as a minimum all specified tests. All concrete aggregate tests shall be at the Contractor's expense.

Aggregate shall be sampled and graded in accordance with ASTM D 75 and C 136.

Sieves for testing grading of aggregates shall have square openings.

Sieve analyses of the fine and coarse aggregates being used shall be furnished the Engineer in triplicate at any time there is a significant change in the grading of the materials, and in any event, shall be furnished at least every three weeks. If such sieve analyses indicate a significant change in the materials, the Engineer may require that a new mix design be submitted for review and acceptance before further placing of concrete.

If either fine or coarse aggregate is to be batched from more than one bin, analyses shall be furnished for each bin, and a composite analysis made up from these, using the proportions of materials to be used in the mix.

The unit weight of fine and coarse aggregate shall be of a unit weight which will produce in place concrete with a weight of not less than 140 pounds per cubic foot.

030121 FINE AGGREGATE

Fine aggregate for concrete or mortar shall consist of clean, natural sand or of sand prepared from crushed stone or crushed gravel. Deleterious substances shall not be present in excess of the following percentages by weight of contaminating substances. In no case shall the total exceed 3 percent.

	<u>Test Method</u>	<u>Percent</u>
Removed by decantation (dirt, silt, etc.)	ASTM C 117	3
Shale or chert	ASTM C 295	1
Clay lumps	ASTM C 142	1

Fine aggregate shall not contain strong alkali nor organic matter which gives a color darker than the standard color when tested in accordance with ASTM C 40. Fine aggregate shall have a fineness modulus not less than 2.50 nor greater than 3.00 when tested in accordance with ASTM C 125. Except as

otherwise specified, fine aggregate shall be graded from coarse to fine in accordance with the requirements of ASTM C 33. Aggregate soundness shall comply with the requirements of ASTM C 33 when tested in accordance with ASTM C 88. Aggregate shall comply with the reactivity requirements contained in ASTM C-33 when tested in accordance with ASTM C-289.

030122 COARSE AGGREGATE

Coarse aggregate shall consist of gravel or crushed stone made up of clean, hard, durable particles free from calcareous coatings, organic matter, or other foreign substances. Thin or elongated pieces having a length greater than five times the average thickness shall not exceed 15 percent by weight. Deleterious substances shall not be present in excess of the following percentages by weight, and in no case shall the total of all deleterious substances exceed 2 percent.

	<u>Test Method</u>	<u>Percent</u>
Soft fragments or particles	ASTM C 851	2
Shale or chert	ASTM C 295	1
Coal and lignite	ASTM C 123	1/4
Clay lumps and friable particles	ASTM C 142	1/4
Materials finer than No. 200 sieve	ASTM C 117	1/2 *

* Except that when material finer than No. 200 sieve consists of crusher dust, the maximum amount shall be 1 percent.

Aggregate when tested in accordance with ASTM C 88 for soundness shall have a loss not greater than 10 percent when tested with sodium sulfate.

Abrasion loss of coarse aggregate shall not exceed 45 percent after 500 revolutions when tested in accordance with ASTM C 131. Coarse aggregate reactivity shall not exceed the limits specified in the appendix of ASTM C 33 when tested in accordance with ASTM C 289.

Except as otherwise specified or authorized in writing by the Engineer, coarse aggregate shall be graded as specified in ASTM C 33, Size No. 57. Coarse aggregate for Class CE concrete for encasement of electrical conduits shall be graded as specified in ASTM C 33, Size No. 8; concrete utilizing this aggregate will be equal to Class C concrete in all other respects, and will be designated as Class CE.

030150 WATER

Water for concrete, washing aggregate, and curing concrete shall be clean and free from oil and deleterious amounts of alkali, acid, organic matter, or other substances. Water shall not contain more than 1,000 milligrams per liter of chlorides calculated as chloride ion, nor more than 1,000 milligrams per liter of sulfates calculated as sulfate ion for conventional reinforced concrete. Water for prestressed or post-tensioned concrete shall not contain more than 650 milligrams per liter of chlorides calculated as chloride ion, nor more than 800 milligrams per liter of sulfates calculated as sulfate ion.

030160 PORTLAND CEMENT

Except as otherwise specified all Portland cement shall conform to the specifications and test for Portland cement ASTM C 150, Types II or III, Low Alkali. Low alkali Portland cement shall contain not more than 0.6 percent total alkali. The word "alkali" shall be taken to mean the sum of sodium oxide and potassium oxide calculated as sodium oxide. The determination for total alkali shall be made by the method set forth in ASTM C 114. Only one brand of Portland cement shall be used for exposed concrete in any individual structure.

030180 ADMIXTURES - GENERAL

Admixtures of any type, except as otherwise specified, shall not be used unless written authorization has been obtained from the Engineer. Admixtures used shall be compatible with the concrete and other admixtures. Admixtures containing chlorides calculated as chloride ion in excess of 0.5 percent by weight shall not be used. Admixtures shall be used in accordance with the manufacturer's recommendations and shall be added separately to the concrete mix.

030181 AIR ENTRAINING ADMIXTURE

Concrete exposed to weathering shall contain 5 percent, plus or minus 1 percent, entrained air of evenly dispersed air bubbles at the time of placement. The air entraining agent shall contain no chlorides and shall conform to ASTM C 260. 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.

The Contractor shall test the percent of air entrained in the concrete. The Contractor shall provide the test equipment. Concrete that does not meet the Specification requirements as to air entrainment shall not be used, and shall be removed from the job. The Contractor shall test the percent of entrained air in the concrete at the beginning of each placement, as often as necessary to keep the entrained air within the specified range, and when requested to do so by the Engineer. The Engineer may at any time test the percent of entrained air in the concrete received on the job. Air entrainment in the concrete shall be tested in accordance with ASTM C 173.

030183 WATER REDUCING ADMIXTURE

A water reducing admixture may be used at the Contractor's option. Such admixtures shall conform to ASTM C 494, Type A or Type D. The admixture shall not contain air entraining agents. Admixture shall be in liquid form before adding to the concrete mix. No decrease in cement shall be permitted as a result of a water reducing admixture.

030200 FORMS AND ACCESSORIES

Forms shall be so constructed that the finished concrete will conform to the shapes, lines, grades, and dimensions indicated on the Plans. It is intended that the surface of the concrete after stripping shall present a smooth, hard, and dense finish that will require a minimum amount of finishing. Sufficient number of forms shall be provided so that the work may be prosecuted rapidly and present a uniform appearance in form patterns and finish. Forms shall be clean and free from all dirt, debris, concrete, etc. and shall be coated with an acceptable form oil if required, prior to use or reuse.

The design of all concrete forms, falsework, and shoring shall be the responsibility of the Contractor and the design and installation of these items shall comply with all local, State, and Federal regulations.

Information on the Contractor's proposed forming system shall be submitted in such detail as the Engineer may require to assure himself that the intent of the Specifications can be complied with by the use of the proposed system. Except as otherwise specified, or accepted in writing by the Engineer, only forming systems by manufacturers with a minimum of five years' experience shall be considered.

Vertical forms shall remain in place a minimum of 24 hours after the concrete is placed. If, after 24 hours, the concrete is sufficiently hardened to resist surface or other damage, the vertical forms may be removed. Other forms supporting concrete and shoring shall remain in place as follows:

Sides of footings	24 hours (minimum)
Vertical sides of beams, girders, etc.	48 hours (minimum)
Slabs, beams, and girders	10 days (minimum) and until concrete strength reaches 85 percent of the specified strength
Shoring for slabs, beams, and girders	10 days (minimum) and until concrete strength reaches 85 percent of the specified strength
Wall bracing	Until concrete strength of the slab laterally supporting the wall reaches 85 percent of the specified strength

Forms shall not be removed from concrete which has been placed with outside ambient air temperature below 50 degrees F until the concrete has attained 85 percent of specified strength as determined by test cylinders stored in the field under equivalent conditions as the concrete structure. No heavy loading on green concrete (85 percent of specified strength) will be permitted. Immediately after forms are removed, the surface of the concrete shall be carefully examined, and any irregularities in the surface shall be repaired and finished as specified hereinafter.

030201 FORM TIES

Form ties for the forming system selected shall be the cone-snap tie or flat bar type as manufactured by a recognized manufacturer of concrete forming equipment. Forms shall be tied together at not less than 2-foot centers vertically and horizontally. Wire ties or wood spreaders of any form shall not be used. Ties shall be of a type that will accurately tie, lock, and spread the forms. Forms and ties shall be designed to withstand concrete pressures without bulging, spreading, or lifting of the forms. The form tie shall be of such design that when the forms are removed no metals shall be within 3/4 inch of any surface. Holes in the forms for ties shall not allow leakage during placement of concrete.

030202 BUILT-UP PLYWOOD FORMS

Built-up plywood forms may be substituted for a prefabricated forming system subject to the following minimum requirements: full sized (4-foot by 8-foot) plywood sheets must be used except where smaller pieces will cover an entire area. Plywood sheets shall be 5-ply, 3/4-inch, made with 100 percent waterproof adhesive, and the finish surface shall be coated or overlaid with a surface which is impervious to water and the alkaline calcium and sodium hydroxide of cement. Studding shall be not less than 2-inch by 4-inch lumber spaced at 16 inches or 24 inches on center. Closer spacing may be required depending upon the strength requirements of the forms, in order to prevent any bulging surfaces on the faces of finished concrete work. Studs shall be installed perpendicular to the grain of the exterior plys of the

plywood sheets. Wales shall be formed of double 2-inch by 4-inch lumber as a minimum. Studding and wales shall contain no loose knots and shall be free of warps, cups, and bows. The number of reuses of forms will depend upon the durability of the surface coating or overlay used, and the Contractor's ability to maintain the forms in a condition which will produce a flat, smooth, hard, dense finish on the concrete when stripped. Alternate combinations of plywood thickness and stud spacing may be submitted to the Engineer for review and acceptance.

030203 STEEL OR STEEL FRAMED FORMS

Steel forms shall be rigidly constructed and adequately braced for minimum deflection of the finish surface. The finish surface shall be flat without bows, cups, or dents.

Steel framed plywood forms shall be rigidly constructed and braced with joints fitting closely and smoothly. Plywood paneling shall be 5-ply, 5/8-inch or 3/4-inch, made with 100 percent waterproof adhesive, and the finish surface shall be coated or overlaid with a surface which is impervious to water and the alkaline calcium and sodium hydroxide of cement. The number of reuses will depend upon the durability of the surface coating or overlay used.

Built-up plywood forms, as specified above, may be used in conjunction with steel forms or steel framed plywood forms for special forming conditions such as corbels and forming around items which will project through the forms.

030204 INCIDENTALS

Where not shown otherwise on the Plans and Typical Details, all external angles of walkways, slabs, walls, beams, columns, and openings shall have a 3/4-inch bevel formed by utilizing a true dimensioned wood or solid plastic chamfer strip and external angles of walkways, walls, and slabs at expansion, contraction, and construction joints shall be a 1/2-inch bevel formed by utilizing a true dimensioned wood or solid plastic chamfer strip. Reentrant angles may be left square. Level strips shall be installed at the top of all wall concrete placements to maintain a true line at all horizontal construction joints.

Keyways shall be constructed as detailed on the Plans. Material for keyways shall be steel, plastic, or lumber treated with form coating, applied according to label directions.

Pipes, anchor bolts, steps, reglets, castings, and other inserts, as indicated on the Plans or as required, shall be encased in the concrete. Dovetail anchors or ties shall be used in conjunction with the slots or inserts for the various materials as specified under their respective sections and as may be necessary for the required work.

030205 BRACING AND ALIGNMENT OF FORMS

It shall be the Contractor's responsibility to limit deviations in line and grade to tolerances which will permit proper installation of all structurally embedded items or mechanical and electrical equipment and piping.

All formwork shall be securely braced, supported, tied down, or otherwise held in place to prevent any movement of formwork. Adequate provisions shall be made for uplift pressure, lateral bulging of forms, and deflection of forms for slabs and beams.

When a second lift is placed on hardened concrete, special precautions shall be taken in the form work at the top of the old lift and bottom of the new lift to prevent spreading, vertical or horizontal displacement

of forms; and to prevent grout "bleeding" on finished concrete surfaces. Pipe stubs, anchor bolts, and other embedded items shall be set in the forms where required.

Concrete beams or slabs shall not be placed directly on masonry walls so that any of the weight of the concrete either before or after the concrete has set is on the masonry wall, unless the masonry wall is identified on the Plans as "bearing wall."

No concrete shall be placed until all forms have been thoroughly checked by the Contractor for alignment, level, strength, and to assure accurate location of all mechanical and electrical inserts or other embedded items. All cracks, openings, or offsets at joints in the formwork which are 1/16-inch or larger shall be closed by tightening the forms or by filling with an acceptable crack filler.

030206 TOLERANCES

It is the intent that the finished concrete conforms to the shapes, lines, grades, and dimensions indicated on the Plans. It shall be the responsibility of the Contractor to comply with the intent of these Specifications, but it is also recognized that there will be occasions when some deviation will occur or be required. It shall therefore be agreed that the maximum deviation from true line and grade shall not exceed the tolerances listed below at the time of acceptance of the project.

- A. In general all tolerances shall comply with AC1 117-81, paragraphs 2.0 through 2.2 and paragraphs 4.0 through 4.5, except as modified in the following. All slabs shall be uniformly sloped to drain when a slope is indicated. Slabs which are indicated to be level shall have a maximum deviation of 1/8 inch in 10 feet without any apparent changes in grade.
- B. On circular tank walls, the Contractor may deviate from the finish line indicated on the Plans by the use of chord lengths not to exceed 2 feet.
- C. All inserts shall be set to the tolerances required for the proper installation and operation of the equipment or systems to which the insert pertains. The following shall be considered maximum tolerances.

<u>Item</u>	<u>Maximum Tolerance,</u> <u>inches</u>
Sleeves and inserts	plus 1/8 minus 1/8
Projected ends of anchor bolts	plus 1/4 minus 0.0
Anchor bolt setting	plus 1/16 minus 1/16

030220 PREFORMED EXPANSION JOINT MATERIAL

Prefomed expansion joint material shall be sponge rubber or bituminous fiber types as specified herein. Specific type to be used in any application shall be as indicated on the Plans and on the Typical Details. The Contractor shall submit sufficient information on each type of material to the Engineer for review to determine conformance of the material to these Specifications.

Thicknesses and dimensions of the materials shall be as indicated on the Plans or as required according to the way it is used. Expansion joint strips shall be fastened to concrete, masonry, or forms with adhesive. No nailing will be permitted, nor shall expansion joint strips be placed without fastening.

Sponge rubber expansion joint material shall be Cementone Code 3329 as manufactured by W. R. Grace and Company, neoprene sponge rubber expansion joint as manufactured by Burke Concrete Accessories Inc.; or equal.

Bituminous fiber expansion joint material shall be Cone Fiber Expansion Joint Fillers Code 1390 as manufactured by W. R. Grace and company, Burke Fiber Expansion Joint, or equal.

030221 SYNTHETIC SPONGE RUBBER FILLER

Synthetic sponge rubber filler shall be an expanded closed-cell sponge rubber backer rod manufactured from a synthetic polymer neoprene base; or a resilient closed-cell polyethylene foam backer rod. The synthetic sponge rubber filler shall have characteristics suitable for the application intended, including the following:

1. Necessary strength for supporting the sealing compound during application.
2. Sufficient resiliency to prevent significant load transfer across the joint.
3. Resistance to the environmental conditions of the installation.
4. No bonding to the sealing compound.
5. A cellular structure that shall prevent wicking or absorption of water.
6. Compatibility with other materials in the joint, and acceptance by the manufacturer of the sealing compound.

The size of the synthetic sponge rubber filler shall be 25 percent greater than the nominal joint width.

Acceptable products include No. 750.3 Ropax Rod Stock manufactured by the Presstite Division of Interchemical Corporation; Rubatex-Cord manufactured by the Rubatex Corporation; or equal.

Surface preparation and installation of the synthetic sponge rubber filler shall be as recommended by the manufacturer in published instructions. The synthetic sponge rubber filler shall not be stretched beyond its normal length during installation.

030230 CAULKING, JOINTS, AND SEALING

Expansion, contraction, and construction joints shall be constructed as detailed on the Plans and Typical Details, and materials used shall be as specified herein. Pipe and conduit shall be installed in structures as detailed on the Plans and Typical Details, and shall be sealed with the materials specified herein. Doors, windows, louvers, and other items installed in or over concrete openings shall be caulked inside and out with the materials specified herein.

030231 CAULKING

All caulking where indicated on the Plans or as specified, except for masonry construction and where specified otherwise, shall be done with synthetic rubber sealing compound. Caulking shall be completed prior to painting.

Concrete must be thoroughly cured prior to caulking. All surfaces to be caulked shall be dry, clean, and free of dirt, grease, curing compounds, and other residue which might interfere with adhesion of the caulking compound. Concrete, masonry, wood, and steel surfaces shall be cleaned and primed in strict accordance with the manufacturer's recommendations prior to caulking. Sponge rubber filler materials may be used as backing for caulking, if acceptable to the Engineer. Filler material, when used, shall be compressible and untreated.

Caulking shall be applied with a pneumatic caulking gun. Nozzles of the proper shape and size shall be used for the application intended. A continuous bond shall be maintained between the caulking and the sides of the joint to eliminate gaps, bubbles, or voids and to fill the joint in a continuous operation without layering of the compound. All joints and seams shall be caulked by experienced applicators in a neat workmanlike manner.

No caulking shall be applied when the temperature exceeds 120 degrees F to avoid sponging or bubbling of compound. To hasten curing of the compound when used on wide joints subject to movement, the Contractor shall apply heat with infra-red lamps or other convenient means.

Excess caulking shall be removed by soaking and scrubbing before caulking has cured with Chem Seal CS9900; equivalent product of Products Research and Chemical Corporation; or equal. Excess cured material shall be removed by sanding with No. 80 grit sandpaper.

030232 SYNTHETIC RUBBER SEALING COMPOUND

Synthetic rubber sealing compound shall be a multi-part polyurethane designed for continuous submerged condition in water or sewage and exposed to direct sunlight in a dry condition. Synthetic rubber sealing compound shall be PRC 270 as manufactured by Products Research and Chemical Company, Elastothane 227R as manufactured by Pacific Polymers Inc., or equal. Sealing compound shall comply with Federal Specification TT-S-00227e, Type I (pourable grade) and Type II (nonsag), Class A, and the following requirements. Polyurethane sealant shall have the following properties determined at 75 degrees F and 50 percent relative humidity:

- Base - polyurethane rubber
- Solids - not less than 97 percent
- Application Time - not less than 2 hours
- Cure Time - not more than 3 days
- Tack Free Time - 24 hours
- Ultimate Hardness - 35 plus or minus 5 (Shore A)
- Tensile Strength (ASTM D 412) - 300 pounds per square inch minimum
- Ultimate Elongation - not less than 550 percent (ASTM D 412)
- Tear Resistance - not less than 85 pounds per inch (ASTM D 624 Die C)

Color shall be gray to match concrete, unless otherwise indicated, and the temperature service range shall be 50 degrees F to 200 degrees F.

Polyurethane sealant shall be a compound designed to cure at room temperature to a firm, highly resilient rubber.

All surfaces to which synthetic rubber must bond shall be dry and free of dust, dirt, and other foreign residue, rough sand blasted caulking groove to provide a sound surface, and shall be primed with the manufacturer's recommended primer for the particular surface.

Application shall be in strict accordance with the manufacturer's published instructions. Application shall be by means of a pneumatic caulking tool or other acceptable method.

All packages shall be code dated. No material shall be more than six months old when used. Material shall have been kept at temperatures lower than 80 degrees F at all times.

030250 EPOXY INJECTION SYSTEM

Where epoxy injection is required to repair cracks in concrete material, the application shall be subject to review and acceptance by the Engineer.

030251 EPOXY MATERIALS

All epoxy materials shall be new and shall be used within the shelf-life limitations set forth by the manufacturer.

Epoxy shall be a two-part type low viscosity epoxy adhesive material containing 100 percent solids and shall meet or exceed the following characteristics when tested in accordance with the standards specified:

ASTM D 638, Tensile Strength: 9,055 psi at 14 days and 77 degrees F cure.

ASTM D 790, Flexure Strength: 12,000 psi at 14 days and 77 degrees F cure.

ASTM D 695, Compressive Strength: 16,440 psi at 24 hours and 77 degrees F cure.

Bond Strength: Concrete shall fail before failure of the epoxy.

Gel Time In A 5-Mil Film: 4 hours maximum at 77 degrees F.

ASTM D 638, Elongation: 1 percent minimum at 14 days and 77 degrees F.

For dry and damp concrete, the epoxy shall be Sikadur Hi-Mod LV as manufactured by the Sika Chemical Corporation; Adhesive Engineering Company Concessive No. 1380; or equal.

030252 METHOD OF INJECTION OF EPOXY

Adequate surface seal shall be applied to the crack or joint to prevent escape of the epoxy. Entry points shall be established at a distance along the seal not less than the thickness of the cracked member.

A 100 percent solid epoxy adhesive as specified above shall be forced into the crack at the first port with sufficient pressure to advance the epoxy to the adjacent port. The original port shall be sealed and entry shifted to the port at which the epoxy appears. This manner of port-to-port injection shall be continued until each joint has been injected for its entire length.

Before processing, the space in the vicinity of a crack location receiving epoxy shall have been swept and left in a generally clean condition. All joints receiving epoxy under this section shall be cleaned free from dirt, laitance, and other loose matter.

Pump unit used for injection shall be a positive displacement type with interlock to provide an in-line mixing and metering system for the two-component epoxy. The pressure hoses and injection nozzle shall be of such a design as to allow proper mixing of the two components of epoxy. The presence of a standby injection unit may be required.

For small amounts, or where excessive grout pressure developed by a pump unit might further damage the structure, premixed material and a hand caulking gun may be used if acceptable to the Engineer.

Seal all ports, including adjacent locations where epoxy seepage occurs, as necessary to prevent drips or run out. Any condition other than normal shall be reported to the Engineer. Solvents may not be used to thin the epoxy system introduced into the cracks or joints. All work under this Specification shall be performed and conducted in a neat orderly manner.

030260 SURFACE SEALANT SYSTEM

Concrete surfaces which are specified to be sealed watertight shall be sealed with ChemMasters, Spray-Cure & Seal 25 or equal. Material shall be applied as recommended by the manufacturer published instructions. Where concrete continues to sweat or leak, additional coats of the sealer shall be applied.

030261 SEALANT SCHEDULE

Sealant will be applied to the following surfaces: Sidewalk, curb, curb and gutter, exposed walls, waterway, interior floor slab and wet well walls.

030270 EPOXY GEL

Epoxy gel shall be Sikadur Hi-Mod Gel manufactured by Sika Chemical Corporation; Concessive No. 1438 manufactured by Adhesive Engineering Company; or equal. Epoxy gel shall be used for vertical or overhead work, or where a high viscosity epoxy is required. Epoxy gel for vertical or overhead work may be used for horizontal work. All mixing, installing, and curing of epoxy shall conform to the manufacturer's published instructions.

030290 EXPANDED POLYSTYRENE

When expanded polystyrene joint filter is shown on the plans or specified, the filler shall be placed in correct position before concrete is placed against the filler. Holes and joints in the filler shall be filled with caulking to prevent the passage of mortar or concrete from one side of the joint to the other.

Expanded polystyrene shall be a commercially available polystyrene board. Expanded polystyrene shall have a flexural strength of 35 pounds per square inch, minimum, determined in accordance with ASTM Designation: C 203, and a compressive yield strength of between 16 and 40 pounds per square inch, at 5 percent compression. When shown on the Plans, surface of expanded polystyrene shall be faced with hardboard. Hardboard shall be 1/8 inch minimum thickness, conforming to Federal Specification LLL-B-810, any type. Other facing materials may be used provided they furnish equivalent protection. All boards shall be held in place by nails, waterproof adhesive, or other means approved by the Engineer.

030300 REINFORCEMENT

All reinforcing steel shall be new material, of the quality specified, free from excessive rust or scale or any defects affecting its usefulness.

030310 REINFORCING BARS

Reinforcing bars to be embedded in concrete or masonry shall be Grade 60 deformed bars conforming to ASTM A 615 and shall include the supplementary requirements. No field bending of bars will be allowed. All reinforcement bars lacking grade identification marks shall on delivery be accompanied by a manufacturer's guarantee of grade which will identify variations.

All bars shall be new stock free from rust scale, loose mill scale, excessive rust, dirt, oil, and other coatings which adversely affect bonding capacity when placed in the work. A thin coating of red rust resulting from short exposure will not be considered objectionable, but any bars having rust scale, loose mill scale, or a thick rust coat shall be thoroughly cleaned, or shall be rejected and removed from the premises upon order of the Engineer.

Bars shall be delivered bundled and tagged with identifying tags.

Bars shall be cut and bent in accordance with the provisions of ACI 315 and ACI 318. All bars shall be bent cold. Bars shall be free from defects and kinks and from bends not indicated on the Plans.

Reinforcing bars shall be welded where indicated on the Plans or acceptable to the Engineer. Welding shall be performed in accordance with AWS D1.4 "Structural Welding Code Reinforcing Steel."

Shop drawings on reinforcing steel detailed by the Contractor in accordance with the Contract Documents will not be reviewed and returned. The Contractor shall supply the Engineer with a copy of all reinforcing steel detail drawings. Changes to the Contract Documents made by the Contractor in reinforcing steel shop drawings shall be called out in the letter of submittal. Such changes will not be acceptable unless the Engineer has expressed consent to such changes in writing.

030311 PLACING BAR REINFORCEMENT

Reinforcing bars shall be accurately placed and adequately secured in position. Bars at splices shall overlap as specified or indicated on the Plans. If the lap splice length is not specified or indicated on the Plans, bars shall be lap spliced in accordance with ACI 318. Lap splices for masonry, if not specified or indicated on the Plans and not specified in DIVISION 4, shall be in accordance with the Uniform Building Code. Bar supports shall be galvanized steel, shall conform to ACI 315, and shall be furnished in sufficient number to prevent sagging and to support loads during construction, but in no case shall the quantities and locations of the supports be less than indicated in ACI 315. Bar supports, where used in slabs which will be exposed to view, shall be equipped with plastic tips. Reinforcing for concrete placed on the ground shall be supported by standard manufactured chairs, with steel plates for resting on the ground. No use shall be made of brick, broken concrete masonry units, spalls, rocks, or similar material for supporting reinforcing steel.

Unless otherwise indicated on the Plans, reinforcement shall be placed so as to provide the thickness of protective concrete covering as indicated on the Typical Details. If not indicated on the Plans or Typical Details protective covering shall be in accordance with ACI 318.

The Contractor shall submit to the Engineer for review and acceptance samples of all chairs he proposes to use along with a letter stating where each type chair will be used. No concrete shall be placed until this prior acceptance has been obtained.

030312 TYING BAR REINFORCEMENT

Bars shall be fastened securely in place with annealed steel wire ties. Bars shall be tied sufficiently often to prevent shifting. There shall be at least three ties in each bar length (does not apply to dowel laps or to bars shorter than 4 feet, unless necessary for rigidity). Slab bars shall be tied at every intersection around the periphery of the slab and 50% at all other locations. Wall bars and slab bar intersections other than around the periphery shall be tied at not less than every fourth intersection, but at not greater than the following maximum spacings:

	<u>Slab Bars,</u> <u>inches</u>	<u>Wall Bars,</u> <u>inches</u>
Bars No. 5 and smaller	60	48
Bars No. 6 through No. 9	96	60
Bars No. 10 and No. 11	120	96

The above tying requirements do not apply to reinforcement for masonry. For masonry, vertical bars shall be held in position at top and bottom and at intervals not exceeding 192-bar diameters.

Where bars are to be lapped spliced at joints in the concrete, all bars shall project from the concrete first placed, a length equal to the lap splice length indicated on the Plans. Where the lap splice length is not indicated on the Plans, then the lap splice length shall be as specified in ACI 318 and this Division. All concrete or other deleterious coating shall be removed from dowels and other projecting bars by wire brushing or sandblasting before the bars are embedded in a subsequent concrete placement.

The Plans and Typical Details contain general notes concerning amount of reinforcement and placing, details of reinforcement at wall corners and intersections, and details of extra reinforcement around openings in concrete.

030320 WELDED WIRE FABRIC REINFORCEMENT

Welded steel wire fabric shall be welded wire fabric in accordance with ASTM A 185. It shall be of new stock, free from excessive rust when placed in the work. All necessary wiring, spacing chairs, or supports shall be installed to keep the welded wire fabric in place while concrete is being placed. The welded wire fabric shall be bent as shown or required to fit the work. Welded wire fabric shall be rolled or otherwise straightened to make a perfectly flat sheet before placing in the Work. Welded wire fabric shall be lap spliced as indicated on the Plans. If the lap splice length is not indicated on the Plans, the welded wire fabric shall be spliced in accordance with ACI 318.

Welded wire fabric may be used in place of reinforcing steel bars if accepted by the Engineer. The welded wire fabric shall be furnished in flat sheet form. The cross-sectional area per linear foot of wire fabric shall be not less than the cross-sectional area per linear foot of reinforcing bars indicated on the Plans.

030340 THREAD BAR

Thread bars shall have a continuous rolled-in pattern of thread-like deformations along its entire length. Hex nuts and couplers for the bars shall develop 125 percent of the yield strength of the bar. Thread bars shall conform to ASTM 615 Grade 60 with supplementary requirements. Thread bars shall be DYWIDAG Threadbar as manufactured by DYWIDAG Systems International, San Diego, California; ACE ALLtread as manufactured by Advanced Construction Enterprises, Inc., Simpsonville, South Carolina; or equal. Cut threads on regular reinforcing bars shall be not substituted for thread bars.

030400 MIXING CONCRETE

Mixing equipment shall be subject to review and acceptance by the Engineer. Mixers may be of the stationary plant, paver, or truck mixer type. Adequate equipment and facilities shall be provided for accurate measurement and control of all materials and for readily changing the proportions of the material.

The mixing equipment shall be capable of combining the aggregates, cement, and water within the specified time into a thoroughly mixed and uniform mass and of discharging the mixture without segregation.

Concrete mixing plant and equipment shall be maintained in good working order and shall be operated at the loads, speeds, and timing recommended by the manufacturer or as specified.

The cement and aggregate shall be proportioned by weight.

030410 MACHINE MIXING

The batch plant shall be capable of controlling the delivery of all material to within 1 percent by weight of the individual material. If bulk cement is used, it shall be weighed on a separate visible scale which will accurately register the scale load at any stage of the weighing operation from zero to full capacity.

Cement shall not come in contact with aggregate or with water until the materials are in the mixer ready for complete mixing with all mixing water. The procedure of mixing cement with sand or with sand and coarse aggregate for delivery to the jobsite for final mixing and addition of mixing water will not be permitted. Retempering of concrete will not be permitted. The entire batch shall be discharged before recharging. The volume of the mixed material per batch shall not exceed the manufacturer's rated capacity of the mixer.

Mixing shall be done in batch mixers of acceptable type. Each mixer shall be equipped with a device for accurately measuring and indicating the quantity of water entering the concrete, and the operating mechanism shall be such that leakage will not occur when the valves are closed.

Transit-mixed concrete shall be mixed and delivered in accordance with ASTM C 94. The total elapsed time between the addition of water at the batch plant and discharging the completed mix shall not exceed 90 minutes or shall the elapsed time at the jobsite exceed 30 minutes. Under conditions contributing to quick setting, the total elapsed time permitted may be reduced by the Engineer. Each truck mixer shall be equipped with a device for counting the number of revolutions of the drum. Water shall not be admitted to the mix until the drum has started revolving. The right is reserved to increase the required minimum number of revolutions or to decrease the designated maximum number of revolutions allowed, if necessary, to obtain satisfactory mixing, and the Contractor will not be entitled to additional compensation because of such increase or decrease.

In the case of other types of mixers, mixing shall be as follows. The concrete shall be mixed until there is uniform distribution of the materials, and the mixer shall be discharged completely before being recharged. Neither speed nor volume loading of the mixer shall exceed the manufacturer's recommendations. Mixing shall be continued for a minimum of 1-1/2 minutes after all materials are in the drum, and for batches larger than 1 cubic yard the minimum mixing time shall be increased 15 seconds for each additional cubic yard or fraction thereof.

030420 HAND MIXED CONCRETE

Hand mixing of concrete shall be done only when requested by the Contractor in writing and accepted by the Engineer.

Hand mixed concrete shall be prepared on a watertight level platform in batches of not to exceed 1/3 cubic yard each. The required amount of coarse aggregate shall first be spread on the platform in an even and uniform layer, over which the proper proportion of fine aggregate shall then be likewise spread.

The combined depth of both such layers shall not be greater than 1 foot. The required quantity of cement shall then be evenly distributed over the fine aggregate; following which the entire batch shall be turned with shovels at least twice before the water is added. The proper amount of water shall then be uniformly sprinkled or sprayed over the batch which shall thereafter be turned with shovels not less than three times before being removed from the platform.

030500 CONVEYING AND PLACING CONCRETE

Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation or loss of the materials.

030510 CONVEYING CONCRETE

Equipment for chuting, pumping, and conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery end without separation of the materials. Chutes and devices for conveying and depositing concrete shall be so designed and used that the concrete shall be directed vertically downward when discharged from the chute or conveying device.

Chutes for conveying concrete shall be kept thoroughly cleaned by washing and scraping upon the completion of any day's placement.

030520 PLACING AND CONSOLIDATION

No concrete shall be placed without the prior authorization of the Engineer.

Concrete shall not be placed until all reinforcement is securely and properly fastened in its correct position and loose form ties at construction joints have been retightened, nor until all dowels, bucks, sleeves, hangers, pipes, conduits, bolts, and any other fixtures required to be embedded therein have been placed and adequately anchored, nor until the forms have been cleaned and oiled as specified.

Placement of concrete in which initial set has occurred or of retempered concrete will not be permitted.

No concrete shall be placed during rainstorms or high velocity winds. Concrete placed immediately before rain shall be protected to prevent the water from coming in contact with it or winds causing excessive drying. Sufficient protective covering shall be kept on hand at all times for protection purposes.

030521 PLACING CONCRETE

The Contractor shall prepare and submit to the Engineer for review, a proposed sequence of placing concrete showing proposed beginning and ending of individual placements. After acceptance, this sequence shall be adhered to except when specific changes are requested by the Contractor and accepted by the Engineer. The Contractor shall notify the Engineer by written memorandum of his readiness (not just his intention) to place concrete in any portion of the work. This notification shall be such time in advance of the operation as the Engineer deems necessary for him to make final inspection of the preparations at the location of the proposed concrete placing. All forms, steel, screeds, anchors, ties, and inserts shall be in place before the Contractor's notification of readiness is given to the Engineer.

Concrete shall be deposited at or near its final position to avoid segregation caused by rehandling or flowing. Concrete shall not be deposited in large quantities in one place and worked along the forms with the vibrator or otherwise. No concrete shall be dropped freely into place from a greater height than 5 feet.

Tremies shall be used for placing concrete where the drop is over 5 feet. Placement of concrete on slopes shall commence at the bottom of the slope.

Concrete shall be placed in approximately horizontal layers not to exceed 24 inches in depth and shall be brought up evenly in all parts of the forms. Concrete placement shall continue without avoidable interruption, in a continuous operation, until the end of the placement is reached. The placement of concrete in wall forms shall not proceed at a faster rate of rise than 6 feet per hour when the temperature is 70 degrees F or over, and at a lesser rate for lower temperatures.

If it takes more than 20 minutes lapse prior to placement of new concrete over concrete previously placed, the depth of the layers being placed at one time shall be reduced, and/or placing equipment increased, until it is possible to return with the placing operation to previously placed concrete within 20 minutes. If concrete is to be placed over previously placed concrete and more than 20 minutes have elapsed, then a layer of grout not less than 1/2 inch thick nor more than 1 inch in thickness shall be spread over the surface before placing the additional concrete.

The placement of concrete for slabs, beams, or walkways cast monolithically with walls or columns shall not commence until the concrete in the walls or columns has been allowed to set and shrink. The time allowed for shrinkage shall be not less than one hour.

030522 CONSOLIDATING CONCRETE

Concrete shall be placed with the aid of acceptable mechanical vibrators. Vibration shall be supplemented by manual forking or spading adjacent to the forms on exposed faces in order to secure smooth dense surfaces. The concrete shall be thoroughly consolidated around reinforcement, pipes, or other shapes built into the work. The vibration shall be sufficiently intense to cause the concrete to flow and settle readily into place and to visibly affect the concrete over a radius of at least 18 inches.

Sufficient vibrators shall be on hand at all times to vibrate the concrete as placed. In addition to the vibrators in actual use while concrete is being placed, the Contractor shall have on hand one spare vibrator in serviceable condition. No concrete shall be placed until it has been ascertained that all vibrating equipment, including spares, is in serviceable condition.

Special care shall be taken to place the concrete solidly against the forms so as to leave no voids. Every precaution shall be taken to make all concrete solid, compact, and smooth, and if for any reason the surfaces or interiors have voids or are in any way defective, such concrete shall be repaired in a manner acceptable to the Engineer.

030523 REQUIREMENTS DUE TO EXTREME WEATHER CONDITIONS

For concrete placed when the ambient air temperature is above 90 degrees F, the forms and reinforcing steel shall be cooled to below 90 degrees F by water spraying. The temperature of the concrete mix at time of placement shall be kept below 90 degrees F by means possible which do not impair the quality of the concrete.

The Contractor shall secure the Engineer's acceptance for type of equipment to be used for heating materials and/or new concrete in the process of curing during excessively cold weather.

For concrete placed below an ambient air temperature of 40 degrees F, or 45 degrees F and falling, provision shall be made for heating the water. If materials have been exposed to freezing temperatures to the degree that any material is below 35 degrees F, the material shall be heated. Water, cement, or

aggregate materials shall not be heated in excess of 160 degrees F. Concrete in the forms shall be protected by means of covering with tarpaulins, or other acceptable covering, and a means shall be provided for circulating warm moist air around the forms to maintain a temperature of 50 degrees F for at least five days.

For conditions which promote rapid drying of freshly placed concrete such as low humidity, high temperature, and wind, the Contractor shall take corrective measures to minimize the rapid water loss from the concrete. The Contractor shall submit the corrective measures he plans to use for review and acceptance by the Engineer prior to placing concrete.

The Contractor shall provide and use a sufficient number of maximum and minimum self-recording thermometers to adequately indicate the temperature around the concrete.

030524 FOOTINGS AND SLABS ON GRADE

Concrete to be placed on ground or compacted fill shall not be placed until the subgrade is in a moist condition acceptable to the Engineer. If necessary, the subgrade shall be well sprinkled with water not less than 6 nor more than 20 hours in advance of placing concrete. If it becomes dry prior to the actual placing of concrete, it shall be sprinkled again, without forming pools of water. No concrete shall be placed if the subgrade is muddy or soft.

030525 REPAIR OF DEFECTIVE CONCRETE

All defective work shall be removed and replaced or repaired. Any work which has not been constructed in accordance with the Plans and Specifications shall be considered defective.

Correction of defective work shall be as specified herein. No defective work shall be patched, repaired, or covered without inspection by the Engineer. Repair shall have a strength equal or greater than the specified concrete for the area. The Contractor shall provide a mix design for the grout which is proposed for use to the Engineer for review and acceptance. All imperfections in the work shall be chipped out and keyed ready for repair. The dry pack method shall be used for holes having a depth nearly equal to or greater than the least surface dimension of the hole, for cone-bolt, and narrow slots cut for repair. Smooth holes shall be roughened with a rotohammer before repair. The mortar method of replacement shall be used for holes too wide to dry pack and too shallow for concrete replacement and shall be used for comparatively shallow depressions, large or small, which extend no deeper than the reinforcement nearest the surface. Concrete replacement shall be used when holes extend entirely through the concrete section or when holes are more than 1 square foot in area and extend halfway through the section. All surfaces of the set concrete to be repaired shall first be coated with epoxy bonding agent, Adhesive Engineering Concrete No. 1001 LPL; Sika Chemical Corporation, Sikadur Hi-Mod; or equal. No repair shall be made until the Engineer has accepted the method of preparing the surface and proposed method of repair.

The color of the repair concrete dry pack and grout shall match that of the adjoining concrete. The use of white cement may be required to match color.

The Contractor shall prepare test panels for proposed repairs at the beginning of the project for review and approval by the Engineer. This panel will serve as a standard for repairs during the project.

Curing of all repaired concrete shall be the same as specified for concrete.

030600 CURING CONCRETE - GENERAL

All concrete shall be cured by the methods specified herein.

All concrete shall be cured a minimum of seven days.

All concrete that is to be painted shall be water or plastic membrane cured. No curing compound shall be used on any concrete surface that is to receive paint or upon which any material is to be bonded. All other concrete shall be cured by water curing or sprayed curing membrane at the Contractor's option, except floors and slabs which are specified to be sealed with a concrete sealer. Floor slabs may be cured using a plastic film membrane curing.

030601 WATER CURING

All surfaces of concrete being water cured shall be kept constantly and visibly moist day and night for a period of not less than seven days and nights. Each day the forms remain in place may count as one day of water curing. No further curing credit will be allowed for forms in place after contact has once been broken between the concrete surface and the forms. Ties shall not be loosened during the period when concrete is being cured by leaving the forms in place. The top of walls shall be flooded with water at least three times per day, and the concrete surface shall be kept moist at all times during the seven-day curing period.

030602 SPRAYED MEMBRANE CURING

Membrane curing compound shall be a clear type with fugitive dye conforming to ASTM C 309, Type 1D.

The curing compound shall be applied to the concrete surface after repairing and patching, and within one hour after the forms are removed. If more than one hour elapses after the removal of the forms, membrane compound shall not be used and water curing shall be applied for the full curing period. If the surface requires repairing or painting, the concrete shall be water cured.

Curing compound shall not be removed from the concrete in less than seven days. Curing compound may be removed by the Contractor only upon written request by the Contractor and acceptance by the Engineer, stating what measures the Contractor shall take to adequately cure the structure.

Care shall be taken to apply curing compound in the area of construction joints to see that curing compound is placed within the construction joint silhouette. The curing compound placed within the construction joint silhouette shall be removed by sandblasting prior to placing any new concrete.

The Contractor has the option of water curing the construction joint. Any curing compound shall be removed through heavy sandblasting of the joint.

Curing compound shall be applied by a mechanical, power operated spray and mechanical agitator that will uniformly mix all pigment and compound. The compound shall be applied in at least two coats. Each coat shall be applied in a direction opposite to the preceding coat. The compound shall be applied in sufficient quantity so that the surface will have a uniform appearance and will effectively and completely conceal all natural color of the concrete at the time of the spraying. The Contractor shall continue to coat and recoat the surface until the specified coverage is achieved and until a coating film remains on the surface of the concrete. The thickness and coverage of the compound shall be such that the film can be scraped from the surface at any and all points after drying for at least 24 hours.

The Contractor is cautioned that the method of applying curing compound specified herein may require more compound than normally suggested by the manufacturer of the compound and also more than is customary in the trade. The amounts specified herein shall be applied, regardless of manufacturer's recommendations or customary practice, if the Contractor elects to use curing compound in place of water curing.

If the Contractor desires to use a curing compound other than the specified compound, the Contractor shall coat sample areas of concrete wall with the proposed compound and also a similar adjacent area with the specified compound in the specified manner for comparison. Complete data on the proposed compound shall also be submitted for review. If the proposed sample is not equal or better, in the opinion of the Engineer, in all features, the proposed substitution will not be allowed.

Prior to final acceptance of the work, the Contractor shall remove, by sandblasting or other acceptable method, any curing compound on surfaces that will be exposed to view, so that only the natural color of the finished concrete will be visible uniformly over the entire surface.

030603 PLASTIC MEMBRANE CURING

Polyethelene film may be used to cure slabs, and shall be sealed at joints and edges with a small sand berm. The plastic membrane shall be installed as soon as the concrete is finished and can be walked on without damage. The concrete shall be kept moist under the plastic membrane.

030610 CONCRETE FINISHING

Concrete finishes shall be in accordance with the Concrete Finish Schedule indicated on the Drawings. Finish designations shall be as defined below except that all concrete surfaces to be painted shall be "sacked" with cement mortar and whip sand blasted. All form ties shall be removed from all surfaces. Tie holes shall be roughened by heavy sandblasting before repair.

Edges of all joints shall be as indicated on the Drawings. Edges shall include any line where placement is stopped. All wall and slab surfaces at edges shall be protected against concrete spatter and shall be thoroughly cleaned upon completion of each placement.

Cement for finishes shall be from the same source and be of the same type as the concrete to be finished. The addition of white cement may be required to produce a finish which matches the color of the concrete to be finished. The Contractor shall prepare test panels for F-4 and F-5 finishes and tie-hole repairs for review and approval of the Engineer. The approved panels shall serve as the standard of quality and workmanship for the project.

A. The following finishes shall be used for vertical concrete surfaces:

1. FINISH F1: No special treatment other than repair of defective work and filling depressions 1-inch or deeper, and filling tie holes.
2. FINISH F2: No special treatment other than repair of defective work, removal of fins, filling depressions 1/2-inch or deeper, and filling tie holes.
3. FINISH F3: Finish F3 shall have defective work repaired, fins removed, and all offsets and projections ground smooth, and shall have all depressions 1/4-inch or larger in depth or width filled with mortar, and tie holes filled.

4. FINISH F4: The finish specified for Finish F3, and, in addition shall have all depressions and holes 1/16-inch or larger in width or depth filled with mortar. The mortar shall consist of 1 part cement and 1-1/2 parts of fine sand passing the No. 100 screen mixed with enough water and an emulsified bonding agent to have the consistency of a thick cream. The surfaces shall be "brush off" sandblasted prior to filling holes to expose all holes near the surface of the concrete. The surfaces shall be thoroughly wetted, and filling of all pits, holes, and depressions shall commence while the surface is damp. Filling shall be done by rubbing the mortar over the entire area with clean burlap, sponge rubber floats, or trowels. No material shall remain on the surface except that within the pits and depressions. The surfaces shall be wiped clean and moist cured.
5. FINISH F5: Exterior concrete surfaces exposed to view shall receive the same finish specified for Finish F3, and, in addition, shall receive a special stoned finish. The procedure shall be as follows:

Forms shall be removed as specified herein and all required repairs, patching, and pointing performed. The surfaces shall be wet thoroughly with a brush and rubbed with a hard wood float dipped in water containing two pounds of Portland cement per gallon. The surfaces shall be rubbed until all form marks and projections have been removed. The grindings from the rubbing operations shall be spread uniformly over the surface with a brush in such a manner as to fill all pits and small voids.

The brushed surface shall be moist cured and allowed to harden for three days, after which a final finish shall be obtained by rubbing with a carborundum stone of approximately No. 50 grit until the entire surface has a smooth texture and is uniform in color. Curing shall be continued for the remainder of the specified time. If any concrete surface should be allowed to become too hard to finish in the above specified manner, all related surfaces exposed to view, whether finished or not, shall be sandblasted and washed. While still damp, a plastic mortar, consisting of 1 part cement to 1-1/2 parts of sand which will pass a No. 16 screen, shall be rubbed over the surface and handstoned with a No. 60 grit carborundum stone, using additional mortar until the surface is evenly filled without an excess of mortar. Stoning shall be continued until the surface is hard. After moist curing for three days, the surface shall be made smooth in texture and uniform in color by use of a No. 50 or No. 60 grit carborundum stone. After stoning, curing shall continue until seven day curing period is completed.

- B. After proper and adequate vibration and tamping, the following finishes shall be used for horizontal concrete surfaces:
 1. FINISH S1: Screeded to grade and left without special finish.
 2. FINISH S2: Smooth steel trowel finish.
 3. FINISH S3: Steel trowel finish free from trowel marks. The finish shall be smooth and free of all irregularities.
 4. FINISH S4: Steel trowel finish, without local depressions or high points, and in addition, shall be given a light hairbroom finish. Stiff bristle brooms or brushes shall not be used. Brooming shall be parallel to slab-drainage. Resulting finish shall be rough enough to provide a nonskid finish. Finish shall be subject to review and acceptance by the

Engineer.

5. FINISH S5: Steel trowel finish, without local depressions or high points, and in addition, shall be given a light broom finish. Stiff bristle brooms or brushes shall not be used. A nonslip abrasive shall be applied per section 030611 NONSLIP ABRASIVE. Resulting finish shall be rough enough to provide a nonskid finish. Finish shall be subject to review and acceptance by the Engineer.

030610.01 FINISHING

Concrete surfaces shall be finished as indicated on the Plans and Typical Details. Where not specified or indicated on the Plans, the surfaces shall be finished as follows:

The following surfaces shall be troweled, then given a light hair broom finish:

- Exterior walkways
- Exterior concrete slab surfaces

The following surfaces shall be screeded off to grade and left rough:

- Projecting footings which are to be covered with dirt
- Slab surfaces which are to be covered with concrete fill

The following surfaces shall receive a smooth steel trowel finish:

- Tops of walls and beams not covered above
- Tops of all slabs not covered above herein
- Pump Station Floor

The final steel trowel finish shall be uniformly smooth and free of all irregularities. Building and machine room floors which are not to be covered with surfacing material shall be free from trowel marks. Trowel marks will be permitted in other locations. Concrete floor surfaces to which a surfacing material is to be applied shall be finished level and smooth with a tolerance of not over 1/8 inch in 10 feet in any direction.

Edges of all control joints shall be as indicated on the Plans and Typical Details. Edges shall include any line where placement is stopped. All wall and slab surfaces at edges shall be protected against concrete spatter and shall be thoroughly cleaned upon completion of each placement.

030611 NONSLIP ABRASIVE

Nonslip abrasive shall be an aluminum oxide abrasive of size 8/16, as manufactured by the Exolon Company, Tonawanda, New York; equivalent product by Abrasive Materials, Inc., Hillsdale, Michigan; or equal. The structure of the aggregate shall be hard, homogenous, nonglazing, rustproof, and unaffected by freezing, moisture, or cleaning compounds.

Application of the nonslip abrasive shall be done after the concrete has been screeded level and hardened enough to support a man standing on a board. The abrasive shall then be sprinkled from a shake screen into the surface at a uniform rate of 25 pounds for each 100 square feet of surface area and wood floated into the finish. It shall then be troweled into the surface with a steel trowel. The nonslip abrasive shall be properly exposed in the surface and provide a nonslip surface.

030700 CEMENT MORTAR AND GROUT

Cement mortar or grout for the repair of imperfect concrete work, filling of holes left by form bolts or ties, and the filling of voids around items through the concrete, and grout for spreading over construction joints and cold joints etc., shall consist of Portland cement and sand mixed in the same proportions used for the concrete being repaired, with only sufficient water to give the required consistency. Essentially, this would consist of the concrete mix with the coarse aggregate removed and water quantity required. In no case shall the water-cement ratio be more than that specified for the concrete being repaired. In the case of mortar being used for patching or repairing exposed concrete surfaces which are not to be painted or which will not be submerged in water, sufficient white cement shall be used to make the color of the finished patch match that of the surrounding concrete. Bolt and tie holes shall be roughened with a rotohammer filled with dry-pack mortar, well tamped into the holes. For dry-pack mortar, only enough water shall be used so that the resulting mortar will crumble to the touch after being "balled."

Concrete surfaces shall be roughened with a rotohammer, cleaned, and thoroughly damp before grout or mortar is placed, or, where indicated on the Plans or specified, an epoxy bonding agent, such as Concessive No. 1001 LPL as manufactured by Adhesive Engineering Company, Sikadur Hi-Mod as manufactured by the Sika Chemical Corporation, or equal, shall be applied to the clean, roughened, dry surface before placing the mortar or grout.

Grout for spreading over the surfaces of construction joints or cold joints shall consist of sand and cement with no more water used than allowed by the water-cement ratio specified for the concrete.

Particular care shall be exercised in placing cement mortar or grout since it will be expected to furnish structural strength or an impermeable water seal or both. Cement mortar or grout that has not been placed within 30 minutes after mixing shall not be used.

Grout for which the mix is not otherwise specified shall be mixed in the proportions by volume of one part cement to four parts of concrete sand.

030710 NON-SHRINK GROUT

Non-shrink grout shall be made with hydraulic cement, which when mixed with water will harden rapidly to produce a permanent high strength material suitable for exterior use. Non-shrink grout shall be nonmetallic and shall not contain calcium chloride or other chemicals which accelerate the corrosion of embedded steel. The grout shall show no shrinkage prior to initial setting in accordance with ASTM C 827 and shall show no shrinkage in the hardened state when tested in accordance with ASTM C 157 and Corps of Engineers CRD C-621. Non-shrink grout shall be Five Star Grout manufactured by U.S. Grout Corporation, Masterflow 713 Grout manufactured by Master Builders, or equal.

When mixed in accordance with manufacturer's published instructions, the nonshrink grout shall be semi-fluid and suitable for placing by pouring into place when mixed to a flowable consistency. The compressive strength tested in accordance with ASTM C 109 shall be not less than 3,000 psi at 1 day and not less than 6,000 psi at 28 days. Setting time tested in accordance with ASTM C 191 shall be not less than 30 minutes.

030720 EPOXY GROUT

Epoxy grout shall be used where specified herein or where shown on the Plans. Epoxy grout may be used to repair surface defects in concrete work.

Epoxy grout shall be made by mixing one part epoxy with not more than two parts sand. The sand shall be clean, bagged, graded, kiln dried silica sand. The prepared grout shall wet the contact surface and provide proper adhesion or a coat of epoxy shall be applied prior to placing the epoxy grout. Manufacturer's published instructions for mixing and application shall be followed.

For vertical or overhead work the epoxy shall be Sikadur Hi-Mod Gel, manufactured by Sika Chemical Corporation; Concessive No. 1438, manufactured by Adhesive Engineering Company; or equal. For horizontal work the epoxy shall be Sikadur Hi-Mod LV, manufactured by Sika Chemical Corporation; Concessive No. 1001 LPL, manufactured by Adhesive Engineering Company; or equal. Epoxy grout for vertical or overhead work may be used for horizontal work.

030800 SPECIAL CONCRETES

030811 CONDUIT ENCASEMENT

All concrete used for the encasement of electrical ducts, conduits, etc. shall be colored red by mixing into each cubic yard of concrete 10 pounds of red oxide No. 1117 as manufactured by the Frank D. Davis Company; equivalent product by I. Reiss Company, Inc.; or equal.

*** END OF DIVISION 3 ***

DIVISION 4

MASONRY

040000 GENERAL

The work includes all labor, materials, equipment, and appliances required to complete the masonry work as indicated on the Plans and specified herein. Masonry shall include, but is not limited to, concrete masonry units, mortar, grout, and all miscellaneous materials, complete in place, constructed as specified herein and/or shown on the Plans.

040105 CONCRETE MASONRY UNITS

Concrete masonry units shall be manufactured to meet ASTM C90, Type I, A615. CMU design strength $f'_m = 2000$ psi for hollow load bearing concrete masonry units. Units shall be 8" x 8" x 16" manufactured by Interstate Brick Company or equal with a "smooth face" or "split face" style and texture as indicated on the plans. Colors shall be as per plans by the owner.

The basic nominal sizes of masonry units shall be 8 inches wide 8 inches high and 16 inches in length or as indicated on the Plans. The thickness shall be governed by the conditions indicated on the Plans. Proper sizes shall be used to provide for all window and door openings, bond beams, piers, lintels, etc. with a minimum of brick cutting. The split face texture shall provide a uniform color and shape throughout the complete wall.

Units shall be ordered well before commencement of work to assure adequate time for manufacturing. Units shall be from a uniform run from one manufacturer. Units shall have integral water repellent. Color shall be selected by the Owner.

040110 CONCRETE MASONRY UNIT SUBMITTALS

Before moving any materials to the site or commencing any of the work in this section, the Contractor shall submit the following items for review and acceptance by the Engineer.

040111 SAMPLES

Furnish two samples of each size and type of concrete masonry units to be used on the project. Samples shall show the range of texture and/or color of the exposed surface for all units, and all units delivered to the job shall fall within this range. Samples shall include special units such as bond beam units, pilaster units, units with end web removed, and other special units.

040112 TESTS

Furnish certified test reports of three sample concrete masonry units of each type proposed to be used on the job, performed by an acceptable testing laboratory indicating that the materials proposed for use meet the requirements of these Specifications. Test results shall include, but not be limited to, compressive strength, linear shrinkage, total absorption, moisture content as a percent of total absorption, and unit weight. Tests shall be performed in accordance with ASTM C 90, ASTM C 140 and ASTM C 426.

Test results of mortar and grout samples as specified in the following are also required.

040113 DRAWINGS

The Contractor shall submit for review and approval a wall elevation drawing for each wall setting forth the type of unit to be used and layout of units. Any special unit such as bond beam units, open ended web units, pilaster units and other special units shall be indicated.

040120 CONSTRUCTION

040120.01 GENERAL

All work shall be executed in a workmanlike manner and in full compliance with all applicable codes and ordinances.

All sills, ledges, offsets, and other projections shall be protected from droppings or mortar, and all construction by other trades shall be protected from effects of masonry work.

All concrete masonry walls shall be laid in uniform and true courses, level, plumb and without projection or offset of adjacent block. The foundation shall be thoroughly cleaned of all laitance, grease, oil, mud, dirt, mortar droppings, or other objectionable matter by means of a bush hammer or heavy sandblasting before placing the first course of masonry units. Full mortar bedding shall be used for the first course on the foundation. Full mortar coverage shall be provided on all face shells and webs. Vertical head joints shall be buttered well for a thickness equal to the face shell of the masonry unit, and these joints shall be shoved tightly so that the mortar bonds well to both masonry units. Joints shall be solidly filled from the face of the masonry units to the depth of the face shell.

Masonry units shall be laid in the wall to the desired height with joints of uniform thickness. Units shall be leveled, plumbed, and straightened before the mortar has stiffened. Bond shall be plumb throughout.

All masonry units shall be laid to preserve the unobstructed vertical continuity of the cells to be filled. Walls and cross webs forming such cells to be filled shall be full-bedded in mortar to prevent leakage of grout or insulation. All head joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells.

Masonry units shall be laid in such a way that cracks are not formed at the time the masonry unit is placed in the wall.

Each masonry unit shall be adjusted to its final position in the wall while the mortar is still soft and plastic enough to insure a good bond. If the position of the masonry unit is shifted after the mortar has stiffened, or bond is broken or cracks are formed, the masonry unit shall be re-laid in new mortar.

Masonry units shall be cured and dried before being used and surface shall be clean and free from dirt when laid in the walls. Masonry units shall not be wetted before being used but shall be laid dry.

040120.02 MORTAR JOINTS

Mortar joints shall be straight, clean, smooth, and uniform in thickness and, unless otherwise noted or indicated on the Plans, shall be tooled slightly concave. Joint thickness shall be 3/8-inch both vertical and horizontal unless otherwise shown. Where fresh masonry joins totally or partially set masonry, the set masonry shall be cleaned and roughened before laying new work.

040120.04 BOND PATTERN

Bond pattern shall be as indicated on the Plans. Where no bond pattern is shown, the wall shall be laid up in a straight, uniform course with regular running bond.

040120.05 GROUTING AND VERTICAL REINFORCEMENT

All spaces and cells containing vertical bar reinforcement shall be filled solidly with grout. Vertical cells containing bar reinforcement shall be filled solidly with grout in lifts not exceeding 8 feet in height. When the grouting is stopped for one hour or longer, horizontal construction joints shall be formed by stopping the pour of grout 1-1/2 inches below the top of the uppermost unit.

Vertical cells to be filled shall have vertical alignment sufficient to maintain a clear, unobstructed continuous vertical cell measuring not less than 2 inches by 3 inches. Cleanout openings shall be provided at the bottoms of all cells to be filled at each lift or pour of grout where such lift or pour of grout is in excess of 4 feet in height. Any overhanging mortar or other obstruction or debris shall be removed from the insides of such cell walls. The cleanouts shall be sealed after inspection and before grouting. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 192 diameters of the reinforcement. Bars shall be held in position by steel wire bar positioners or tied to dowels with wire ties.

Vertical reinforcing bars shall be centered in the cells. Where bars are spliced, the splice shall not be less than 62 bar diameters and footing dowels shall lap the vertical reinforcing bars 62 bar diameters. After grout has been placed, it shall be consolidated by rodding or by use of an immersion vibrator designed for the purpose.

Reinforcing steel shall be in place and reviewed by the Engineer before grouting shall begin.

040120.07 CUTTING OF MASONRY UNITS

All necessary cutting of concrete masonry units to form chases, etc. for anchorage or other appurtenances shall be required. All cutting and fitting of exposed block units shall be done with a power-driven carborundum or diamond disc blade saw.

040120.08 CONTROL JOINTS

Control joints shall be as indicated in the Plans or as specified. They shall be full height and continuous in appearance, although bond beams and bond beam reinforcing bars shall be continuous through the joint. The control joint shall be caulked and shall be mortar joint in appearance. Fill material for control joints shall be pre-molded, wide flange control joint filler as specified elsewhere herein. Caulking shall also be as specified elsewhere herein. All joints shall be caulked to produce a weathertight structure.

040120.09 OPENINGS AND LINTELS

Openings in masonry walls, unless indicated or specified otherwise, shall have lintels made up of like units (bond beam units) reinforced and filled solidly to properly span the opening. Solid bottom bond beam block shall be used where the underside of lintel is exposed. Provide a minimum of 8 inches bearing at each end of lintel. Extend reinforcing 48 diameters into wall past edge of opening on each side of opening.

040120.10 DOOR FRAMES

Jambs and head of metal door frames connected to masonry shall be anchored and fully grouted. Filling of frames shall be done as each 2 feet of masonry is laid.

040120.11 BEARING PLATES

A 12-inch minimum depth of grouted hollow masonry shall be provided below all steel bearing plates or beams bearing on masonry walls. Extend bearings each side of contact with load as required to properly transfer loads into masonry walls and/or as indicated on Plans.

040120.12 ANCHOR BOLTS

A 6-inch minimum width of grouted hollow masonry shall be provided all around anchor bolts and other attachment locations. Anchor bolts shall be held in place by a template to assure precise alignment of anchor bolts. Cutting, reaming or other means of accommodating misaligned anchor bolts in support angles will not be accepted.

040120.13 HANDLING OF MASONRY UNITS

All masonry units shall be transported and handled in such manner as to prevent chipping and breakage. Storage piles, stacks, or bins shall be located to protect materials from heavy traffic. Chipped, cracked, or otherwise defective units shall be removed from the work. Any unit that is chipped, cracked, broken, or otherwise defective, whether before or after setting, will be rejected and shall be removed and replaced.

040120.14 TIES

Where two or more units are used to make up the thickness of a wall, the units shall be bonded with 3/16-inch diameter galvanized steel rods or metal ties of equivalent stiffness embedded in the horizontal joints. Rods shall be bent in a rectangular shape. There shall be one metal tie for not more than each 4-1/2 square feet of wall area. Ties in alternate courses shall be staggered and the maximum vertical distance between ties shall not exceed 18 inches and the maximum horizontal distance shall not exceed 36 inches.

040120.15 ENCLOSURES

Where concrete masonry is to enclose conduits, pipes, stacks, ducts, and similar items; chases, cavities, and similar spaces shall be constructed as required, whether indicated on the Plans or not. Openings around flush mounted electrical outlet boxes including the flush joint above the box, shall be pointed with mortar. No such work shall be covered until advised that work has been inspected and tested.

040120.16 PATCHING

Patching of exposed concrete masonry units shall be done at the conclusion of the general work and shall be done in such a manner that the patching will be indistinguishable from similar surroundings or adjoining work.

040120.17 PROTECTION OF MASONRY

Temporary protection shall be provided for all exposed masonry corners subject to injury. Concrete scum and grout stains on masonry shall be removed immediately. The wall shall be adequately braced against wind and other forces during construction, and bracing shall remain in place until the roof has been erected. When rain or snow is imminent, the tops of unfinished walls shall be fully covered and protected with waterproof paper, polyethylene, or other means accepted by the Engineer.

040120.18 WATER CURING

Masonry shall be protected against too rapid drying by frequently fogging or sprinkling so that walls will always be visibly damp for a period of not less than three days.

040120.19 MISCELLANEOUS

All items as required, including all anchors, flashings, sleeves, frames, structural steel, loose lintels, anchor bolts, miscellaneous iron, and all other items required shall be built in for a complete job.

040130 MASONRY SEALER

Exterior masonry shall be coated with not less than three coats of clear water repellent sealer. Sealer shall be applied in accordance with the manufacturer's instructions and shall be applied in such quantity as to positively seal the entire surface. The sealer shall not discolor the surfaces to which applied. Sealer shall be applied not less than 30 days prior to application of any coatings to the masonry. Sealer shall be a detergent based such as Chem-Stop Heavy Duty Clear Waterproofing, Thompson's Water Seal 201, or equal. No acid or acid-based sealants or cleaners shall be used.

040140 COLD WEATHER PROTECTION OF MASONRY

Masonry work to be done when the mean daily air temperature is 40 degrees F, or less, shall comply with the following requirements: heat mixing water and aggregate to a minimum of 70 degrees F and maximum of 160 degrees F. Provide enclosure and heat to maintain air temperature above 40 degrees F. Temperature of masonry units shall be minimum 35 degrees F when laid. Maintain masonry temperature above 40 degrees F for three days by use of enclosures and supplemental heat.

040150 LOOSE FILL INSULATION IN WALLS

Exterior walls of all buildings shall have such masonry unit cells as are not filled with grout, filled with insulation. Insulation shall be vermiculite in accordance with Federal Specification HH-I-585C, Type II and ASTM C 516 or loose perlite in accordance with ASTM C 549 (loose) Type IV. Perlite shall be silicon treated for moisture and treated for dust. The cells in the masonry unit wall shall be kept as free of mortar as possible as the masonry goes up. Cells shall be filled with insulation poured into place, and the masonry unit laying shall not be carried more than 4 feet vertically ahead of the insulation fill. That is, the insulation shall be poured in lifts not to exceed 4 feet. Care shall be taken that no insulation fill gets into cells which are to be filled with grout and that no grout gets into cells that are to be filled with insulation.

Insulation fill shall be asbestos free.

040160 CLEAN UP

Extreme care shall be taken to prevent mortar splashes. No construction supports shall be attached to the wall except where specifically permitted by the Engineer. Concrete and grout spilled on the wall shall be washed off before it sets. All grout stains shall be removed from walls. At the conclusion of the masonry work, the Contractor shall clean all masonry walls, remove scaffolding and equipment used in the work, clean up all debris, refuse, and surplus material, and remove them from the premises. The Contractor also is responsible for correcting any efflorescence on exposed masonry units or joints.

040230 MASONRY SEALER

Exterior masonry shall be coated with not less than three coats of clear water repellent sealer. Sealer shall be applied in accordance with the manufacturer's instructions and shall be applied in such quantity as to positively seal the entire surface. The sealer shall not discolor the surfaces to which applied. Sealer shall be applied not less than 30 days prior to application of any coatings to the masonry. Sealer shall be a detergent based such as Chem-Stop Heavy Duty Clear Waterproofing, Thompson's Water Seal 201, or equal. No acid or acid-based sealants or cleaners shall be used.

040240 COLD WEATHER PROTECTION OF MASONRY

Masonry work to be done when the mean daily air temperature is 40 degrees F, or less, shall comply with the following requirements: heat mixing water and aggregate to a minimum of 70 degrees F and maximum of 160 degrees F. Provide enclosure and heat to maintain air temperature above 40 degrees F. Temperature of masonry units shall be minimum 35 degrees F when laid. Maintain masonry temperature above 40 degrees F for three days by use of enclosures and supplemental heat.

040260 CLEAN UP

Extreme care shall be taken to prevent mortar splashes. No construction supports shall be attached to the wall except where specifically permitted by the Engineer. Concrete and grout spilled on the wall shall be washed off before it sets. All grout stains shall be removed from walls. At the conclusion of the masonry work, the Contractor shall clean all brick walls, remove scaffolding and equipment used in the work, clean up all debris, refuse, and surplus material, and remove them from the premises. The Contractor also is responsible for correcting any efflorescence on exposed masonry or joints.

043000 MASONRY MORTAR AND GROUT

The following paragraphs establish the minimum requirements for masonry mortar and grout. The Contractor is responsible for providing mixes which comply with the minimum strength requirements.

043010 MORTAR

Mortar for concrete masonry units shall be Type S mortar in accordance with ASTM C 270 sand equal to 2-1/4 to three times the sum of the volume of the cementitious materials and shall consist of 1 part of portland cement, 1/4 part to 1/2 part of lime putty or hydrated lime, and water repellent admixture. Coloring shall be added to the mortar when used with colored masonry units. The type and quantity of coloring to be added shall be as recommended by the manufacturer to match the color of the masonry units.

Water repellent admixture shall be added to all mortar in the quantity recommended by the manufacturer. Mortar shall develop a 28-day compressive strength of not less than 2,650 pounds per square inch.

Testing and special inspections shall be performed per the special inspections schedules on the drawings.

All mortar shall be mixed on the job. No mixing off the job, either complete or part, will be allowed. Materials for mortar shall be measured by volume. Mortar shall be mixed in a mechanical mixer and only in such quantities as are needed for immediate use. Mortar shall be mixed for five minutes after all materials have been added to the mixer. No mortar which has been mixed for more than one hour shall be used. The mixer drum must be completely emptied of materials and washed down before the next batch of materials is placed therein should mix time exceed 90 minutes.

043020 GROUT

Grout mix shall attain a minimum compressive strength of $f'c = 2,000$ pounds per square inch at 28 days. Contractor shall submit product specification to engineer for approval prior to construction.

044000 MISCELLANEOUS MATERIALS

The following materials shall be used where required within the masonry work.

044010 CEMENT

Portland cement shall conform to ASTM C 150, Type II, low alkali. Low alkali cement shall contain not more than 0.6 percent total alkali. The alkali shall mean the sum of sodium oxide and potassium oxide calculated as sodium oxide.

044020 LIME

Quicklime shall conform to ASTM C 5. Hydrated lime shall conform to ASTM C 207, Type S.

044030 AGGREGATE

Except as specified elsewhere, sand for mortar and fine aggregate for grout shall conform to ASTM C 144. Coarse aggregate (pea gravel) for grout shall be clean, hard, fine grained, and shall be free of flat, chip-like, thin, elongated, friable, or laminated pieces. Pea gravel shall be uniformly graded with not more than 5 percent passing the No. 8 sieve and with 100 percent passing the 3/8-inch sieve.

044040 REINFORCEMENT

Reinforcement shall be as shown on the Plans and specified herein. Reinforcement bars in masonry shall be as specified under DIVISION 3.

044050 ADMIXTURE

Admixture additions shall be per manufacturer's recommendations.

044060 WATER

Water shall be clean, potable water, free from oil, soluble salts, chemicals, and other deleterious substances.

044070 ANCHORS

Anchors for anchoring masonry unit facing to concrete shall be acceptable galvanized flat brick anchors inserted in 24-gauge galvanized continuous slots. Anchors for anchoring masonry unit facing to steel beams shall be acceptable 20-gauge galvanized adjustable brick veneer anchors inserted in 20-gauge galvanized channel anchor slots 4 inches long.

044090 CAULKING

All caulking for masonry control joints, around door jambs, window frames, at roof decks, and at other locations in masonry construction shall be done with 1part, non-sag, high performance, polysulfide base sealant. Caulking shall conform to requirements of Interim Federal Specification TT-S-00230C, Type 2, Class A, and shall be Chem Calk 100 by Woodmont Products, Inc.; PRC 7000 by Products Research and Chemical Corp.; or equal. Color shall be selected by the Engineer from manufacturer's standard colors.

Application, including necessary primer and backer rod, shall be per manufacturer's recommendations. Sealant shall not be applied on wet or frosty surfaces or when surface temperature is above 130 degrees F. The depth of sealant in a joint shall not be greater than its width nor less than 1/4-inch. Sealant depths shall be as follows:

<u>Joint Width</u>	<u>Sealant Depth</u>
1/4 inch to 3/8 inch	1/4 inch
1/2 inch to 1 inch	3/8 inch

*** END OF DIVISION 4 ***

DIVISION 5

METALS

050100 STRUCTURAL AND MISCELLANEOUS METALS

050110 GENERAL

This part of the Specifications includes but is not limited to the following items:

Aluminum and miscellaneous nonferrous metals

Anchor bolts

Bolts

Cast iron frames and covers

Grating and frames

Hatches

Ladders

Manhole frames and covers

Metal fasteners and welding

Metal roof decking and siding

Miscellaneous aluminum

Miscellaneous cast iron

Miscellaneous other metal items

Miscellaneous structural steel

Pipe handrails, pipe sleeves, inserts, and gates

Structural steel

Sheet metalwork

Stairs and treads

Stop plank grooves

Tread plates and frames

050120 MATERIALS

Unless otherwise specified or indicated on the Plans, structural and miscellaneous metals shall conform to the standards of the American Society for Testing and Materials (ASTM), including the following:

<u>Item</u>	<u>ASTM Standard No.</u>	<u>Class, Grade, Type or Alloy No.</u>
<u>Cast Iron</u>		
Cast Iron	A 48	Class 40B
<u>Steel</u>		
Galvanized sheet iron or steel	A 653	Coating G90
Black steel, sheet or strip	A 1011	
Coil (plate)	A 36	
Structural plate, bars, rolled shapes, and misc. items	A 36	
Standard bolts, nuts, and washers	A 563 F 436 A 307	Grade A
High strength bolts, nuts, and hardened flat washers	A 325 A 490	
Eyebolts	A 489	Type 1
Hollow Structural Sections, cold-formed	A 500	Grade B
Hollow Structural Sections, hot-formed	A 500	Grade B
Steel pipe	A 53	Grade B
<u>Stainless steel</u>		
Plate, sheet and strip	A 167	Type 304 or 316
Bars and shapes	A 276	Type 304 or 316
<u>Aluminum</u>		
Sheet aluminum-flashing	B 209	Alloy 5005- H14, 0.032 inches min. thickness
Sheet aluminum-structural	B 209	Alloy 6061-T6
Structural aluminium	B 308 B 209	Alloy 6061-T6
Extruded aluminum	B 221	Alloy 6063-T42

Stainless steels are designated by type or series defined by AISI.

050130 FABRICATION AND ERECTION

Fabrication and erection of steel items shall conform to AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings wherever applicable, except as the same may be modified by applicable building codes and these Specifications. Where anchors, connections or other details of miscellaneous metalwork are not definitely indicated on the Plans, or specified in the Specifications, their material, size, form, attachment, and location shall be equivalent in quality and workmanship to items specified herein.

Galvanized structural steel or iron shall be hot-dip galvanized after fabrication in accordance with ASTM A 123. Electro-galvanizing shall not be used unless specified. Galvanized items that bend or twist during galvanizing shall be restraightened. Cut or otherwise damaged galvanized surfaces shall be field repaired to equivalent original condition using Galvinox, Galvo-Weld, or equal.

The Contractor shall take all measurements necessary to properly fit his work in the field, and he shall be governed by and be responsible for these measurements and the proper working out of all details. The Contractor shall be responsible for the correct fitting of all metalwork in the field. Sharp or hazardous projections shall be rounded off and ground smooth. The Contractor shall paint steel and miscellaneous ferrous metal items in accordance with these Specifications.

Where aluminum comes in contact with dissimilar metals, except stainless steel, it shall be bolted with stainless steel bolts and separated or isolated from the dissimilar metals, with neoprene gaskets, sleeves, and washers. Those parts of aluminum which will be cast into concrete or which will be in contact with concrete, masonry, or wood shall be coated as specified elsewhere in these Specifications.

The threads of stainless steel bolts shall be coated, prior to installing the nut, with Never-Seez manufactured by Never-Seez Compound Corporation; WLR No. 111 manufactured by Oil Research, Inc.; or equal.

050500 METAL FASTENING

Unless otherwise indicated on the Plans or specified, metal fastening shall be as follows.

050510 BOLTING

Bolts, except high strength bolts, shall be provided with flat washers and self-locking nuts, or lock washers and nuts. Bolt heads and nuts shall be hex-type. Bolts, nuts, and washers shall be of domestic manufacture.

Bolts, including anchor bolts, nuts, washers, and similar fasteners specified to be galvanized, shall be galvanized in accordance with ASTM A 153.

After installation, bolts, including anchor bolts and concrete anchors, shall project a minimum of two threads but not more than ½ inch beyond the nut.

Unless otherwise specified, bolts, including anchor bolts and concrete anchors, shall be tightened to the snug-tight condition. The snug-tight condition shall be defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench.

050511 HIGH STRENGTH BOLTS

High strength bolts, nuts, and hardened flat washers shall conform to ASTM A 325 or ASTM A 490, as indicated on the Plans.

Joints with high strength bolts shall be considered to be friction-type structural joints and shall conform to the requirements of AISC Specification for Structural Joints Using ASTM A 325 or A 490 Bolts. A hardened flat washer shall be provided both under the element, nut or bolt head, turned in tightening and on short slotted holes of outer plies. Contractor shall notify Engineer in advance of the method selected for tightening and verification pursuant to the referenced AISC Specification.

050512 ASSEMBLY BOLTS

Bolts, nuts, and washers for wood baffles, collectors, and other field assembled construction shall be Type 316 stainless steel in wet and moist locations, including: below and at water level of water containing structures; above water level but below top of walls of water containing structures; above water level but under the roof of enclosed water containing structures; dry side of walls of water containing structures; and pump bases.

Bolts, nuts, and washers shall be Type 304 or Type 316 stainless steel for aluminum assemblies.

Bolts, nuts, and washers shall be hot-dip galvanized ASTM A 307 steel for galvanized assemblies and for applications other than those specified hereinbefore.

050513 EYEBOLTS

Eyebolts manufactured of materials other than carbon steel shall be welded or forged, and shall have the geometric and strength characteristics of eyebolts specified in ASTM A 489, Type 1. The strength characteristics shall include proof load requirements, breaking strength requirements, tensile test requirements, bend test, and impact strength.

050520 FASTENERS FOR USE IN CONCRETE

Fasteners for use in concrete shall be as specified hereinafter. "Slug-in," lead cinch, and similar systems relying on the deformation of lead alloy or similar materials in order to develop holding power shall not be used.

050521 ANCHOR BOLTS

Anchor bolts shall be cast in place when concrete is placed, wherever feasible. Anchor bolts embedded in concrete shall be accurately located and with bolts perpendicular to the surface from which they project.

Anchor bolts, nuts, and washers shall be Type 316 stainless steel in wet and moist locations, including: below and at water level of water containing structures; above water level but below top of walls of water containing structures; above water level but under the roof of enclosed water containing structures; dry side of walls of water containing structures; and pump bases.

Bolts, nuts, and washers shall be Type 316 stainless steel for fastening aluminum to concrete or steel.

Bolts, nuts, and washers shall be stainless steel, hot-dip galvanized ASTM A 307 steel, or hot-dip galvanized ASTM A 36 steel, at the option of Contractor, for applications other than those specified hereinbefore.

Anchor bolts shall not touch reinforcing steel. Where anchor bolts are within 1/4 inch of reinforcing steel, anchor bolts shall be insulated with not less than four wraps of 10-mil PVC tape in the area adjacent to the reinforcing steel.

In anchoring machinery bases subject to heavy vibration, two nuts shall be used, one serving as a locknut. Bolts, when indicated on the Plans for future use, shall be first coated thoroughly with nonoxidizing wax, followed by turning nuts down to the full depth of thread. Exposed thread shall then be neatly wrapped with a waterproof polyvinyl tape.

Anchor bolts shall be embedded not less than 10 diameters and shall have a standard hex bolt head or a 90-degree hook not less than 4 diameters in length. Where indicated on the Plans, anchor bolts shall be set in metal sleeves having an inside diameter approximately 2 inches greater than the bolt diameter and not less than 12-bolt diameters in length. Sleeves shall be filled with grout when the machine or other equipment is grouted in place.

050522 CONCRETE ANCHORS

Concrete anchors shall mean drilled in place anchors with integral threaded studs. Concrete anchors shall not be used in lieu of anchor bolts. Concrete anchors shall be manufactured by ITT-Phillips Red Head, "Wedge Anchors;" "Wej-It" Corporation, "Wej-It" concrete anchors; or equal.

The material of each concrete anchor, including its integral threaded stud, wedge washer, and nut, shall be Type 304 or Type 316 stainless steel.

Concrete anchors shall have the following minimum embedment lengths:

<u>Diameter</u> <u>Inches</u>	<u>Embedment Length</u> <u>Inches</u>
1/4	1-3/4
3/8	1-7/8
1/2	2-1/4
5/8	2-3/4
3/4	3-1/4

Prior to installation or use of concrete anchors, the Contractor shall perform the following test and shall submit the test results to the Engineer. The Contractor shall furnish not less than four 5/8-inch diameter Type 304 or Type 316 stainless steel concrete anchors of the type proposed to be used and install the concrete anchors in a test block of concrete to the specified embedment length. The Contractor shall furnish and install one 5/8-inch nut on each concrete anchor. Each nut shall be tightened with an applied torque of 10 foot-pounds. Each nut shall then be loosened, and then retightened with an applied torque load of 10 foot-pounds. Visible evidence of turning by a concrete anchor shall be cause for rejection of the concrete anchors by the Engineer.

Anchor bolts may be cast in the concrete in lieu of using concrete anchors.

Concrete anchors shall be accurately located and set perpendicular to the surfaces from which they project.

050523 DEFORMED BAR ANCHORS

Deformed bar anchors shall be D2L Deformed Bar Anchors manufactured by Nelson Stud Welding Company; DA Deformed Anchors manufactured by Blue Arc; or equal. Deformed bar anchors shall conform to ASTM A 496.

The deformed bar anchors shall be butt welded with an automatic stud welding gun as recommended by the manufacturer. The weld shall develop the full strength of the anchor.

050524 STUDS

Headed studs shall be S3L Shear Connectors or H4L Concrete Anchors manufactured by Nelson Stud Welding Company; SC Shear Connector Stud or HA Headed Anchors manufactured by Blue Arc; or equal. Headed studs shall conform to ASTM A 108 and shall have a minimum yield strength of 50,000 pounds per square inch and a minimum tensile strength of 60,000 pounds per square inch.

The headed studs shall be butt welded with an automatic stud welding gun as recommended by the manufacturer. The weld shall develop the full strength of the stud.

050525 FLUSH SHELLS

Flush shells shall be used only where specifically indicated on the Plans. Flush shells shall be ITT-Phillips Red Head Multi-Set Drop-In Anchor; Hilti Corporation Hol-Hugger HDI Drop-In Anchor; or equal. Bolts, flush shells, threaded rods, washers, and nuts shall be Type 303 stainless steel. Flush shells shall be accurately located and set perpendicular to the surfaces from which they project.

050526 POWDER ACTUATED FASTENERS

Powder actuated fasteners for installation in concrete or steel shall be zinc coated heat-treated alloy steel. Fasteners not sufficiently protected against corrosion under the conditions to which they will be exposed, shall be coated as necessary to make them suitable for such conditions. Pins shall have a head or threaded stud capable of transmitting the loads that shanks are required to support. Pins connected to steel shall have longitudinal serrations around the circumference of the shank.

Use of powder actuated fasteners shall be limited to only the applications indicated on the Plans or specified in the Specifications.

050527 CONCRETE INSERTS

Concrete inserts for supporting pipe and other applications shall be as specified in DIVISION 15 and elsewhere in these Specifications. Unless otherwise specified, concrete inserts shall be hot-dip galvanized cast iron.

050528 PREFORMED CHANNEL PIPE SUPPORTS

Prefomed channel pipe supports for pipe supports and other applications shall be as specified in DIVISION 15.

050800 WELDING

Welding of structural metals shall be done by welders who have a current American Welding Society (AWS) certificate for the type of welding to be done by the welder. The Contractor shall notify the Engineer at least 24 hours before starting shop or field welding. The Engineer may check the materials, the equipment, and the qualifications of the welders. Welders doing unsatisfactory work shall be removed from the Work, or may be required to requalify.

The Engineer may use gamma ray, magnetic particle, dye penetrant, trepanning, or any other aid to visual inspection which he may deem necessary on any part or all welds to examine the welds.

The cost of retests on defective welds shall be borne by the Contractor. Cost in connection with qualifying welders shall also be borne by the Contractor.

Welds shall be full penetration welds unless otherwise indicated on the Plans.

050810 WELDING ALUMINUM

Welding of aluminum shall be in accordance with AWS D1.2, Structural Welding Code - Aluminum. Detail requirements for welding aluminum alloy 6061-T6 shall be as specified in the following paragraphs.

Filler metal for welding aluminum shall be aluminum alloys conforming to the requirements of AWS A5.10 and shall be AWS classification ER 4043, ER 5654, ER 5554, ER 5183, ER 5356, or ER 556.

Welding of structures which are to be anodized shall be done using filler alloys which will not discolor when anodized. ER 5654, ER 5554, ER 5183, ER 5356, or ER 5556 filler alloys shall be used.

Dirt, grease, forming or machining lubricants, and organic materials shall be removed from the areas to be welded by cleaning with a suitable solvent or by vapor degreasing. Additional operations to remove the oxide coating just prior to welding shall be performed when the inert gas tungsten arc welding method is used. This may be done by etching or by scratch brushing. The oxide coating may not need to be removed if the welding is done with the automatic or semi-automatic inert gas shielded metal arc.

Suitable edge preparation to assure 100 percent penetration in butt welds shall be used. Oxygen cutting shall not be used. Sawing, chipping, machining, or shearing may be used.

Welding of aluminum shall be done using a nonconsumable tungsten electrode with filler metal in an inert gas atmosphere (TIG) or using a consumable filler metal electrode in an inert gas atmosphere (MIG). No welding process that requires the use of a welding flux shall be used.

050830 WELDING STAINLESS STEEL

The general requirements of AWS D1.1, Structural Welding Code - Steel, shall apply to the welding of stainless steel. Welding of stainless steel shall be done with electrodes and techniques recommended in "Welded Austenitic Chromium - Nickel Stainless Steel - Techniques and Properties" distributed by the Nickel Development Institute, Toronto, Canada, and in accordance with AWS D10.4 Recommended Practice for Welding Austenitic Chromium - Nickel Stainless Steel Piping and Tubing.

050850 WELDING STEEL

Welding of steel shall conform to AWS D1.1 Structural Welding Code - Steel.

Welding of ASTM A 36 structural steel, ASTM A 500 and A 501 structural tubing, and ASTM A 53 pipe shall be with electrodes conforming to AWS A5.1 Specification for Carbon Steel Covered Arc Welding Electrodes, using E70XX electrodes; AWS A5.17 Specifications for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding, using F7X-EXXX electrodes; or AWS A5.20 Specifications for Carbon Steel Electrodes for Flux Cored Arc Welding, using E7XT-X electrodes.

051000 STRUCTURAL METAL

Structural or foundry items shall be carefully fabricated to true dimensions without warp or twist. Welded closures shall be neatly made; and where weld material interferes with fit or is unsightly in appearance, it shall be ground off smooth.

Structural items shall be installed accurately and securely, true to level, plumb, in correct alignment and grade, with all parts bearing or fitting the structure or equipment for which intended. Cocking out of alignment, redrilling, reshaping, or forcing to fit fabricated items will not be permitted. Contractor shall place anchor bolts or other anchoring devices accurately and shall make surfaces which bear against structural items smooth and true to level to preclude the necessity of springing, redrilling, or reshaping.

Structural items needing a special alignment to preserve straight, level, even, smooth lines shall be rigidly supported and braced and kept braced until concrete, grout, or dry pack mortar has hardened for a period of not less than 48 hours.

The Contractor shall submit certified copies of mill tests or reports from a recognized commercial laboratory including chemical, tensile, and bending properties of each shipment of structural metal or part thereof having common properties. Tests and analyses shall be made in accordance with the applicable ASTM Standards.

051100 STRUCTURAL ALUMINUM

The Contractor shall furnish and install structural aluminum items as indicated on the Plans and as specified. He shall provide supplementary parts necessary to complete each item even though such work is not definitely indicated on the Plans and specified in the Specifications. Their size, form, attachment, and location shall be such as to conform to the best of current practice.

Materials not otherwise specified shall conform to the applicable ASTM Standards.

051110 ALUMINUM LAYOUT

Hole centers may be center punched and cutoff lines may be punched or scribed. Center punching and scribing shall not be used where such marks would remain on fabricated material.

A temperature correction shall be applied where necessary in the layout of critical dimensions. The coefficient of expansion shall be considered to be 0.000013 per degree F.

051120 CUTTING ALUMINUM

Material 1/2 inch thick or less may be sheared, sawed, or cut with a router. Material more than 1/2 inch thick shall be sawed or routed. Cut edges shall be true and smooth, and free from excessive burrs or ragged breaks. Reentrant cuts shall be avoided wherever possible. If used, they shall be filleted by drilling prior to cutting. Flame cutting of aluminum alloys is not permitted.

Rivet or bolt holes may be punched or drilled to finished size before assembly. The finished diameter of holes for bolts shall be not more than 1/16 inch larger than the nominal bolt diameter. Holes shall be cylindrical and perpendicular to the principal surface. Holes shall not be drifted in such a manner as to distort the metal.

051130 ALUMINUM FORMING AND ASSEMBLY

Structural material shall not be heated, with the following exceptions:

Aluminum material may be heated to a temperature not exceeding 400 degrees F for a period not exceeding 30 minutes to facilitate bending or welding. Such heating shall be done only when proper temperature controls and supervision are provided to ensure that the limitations on temperature and time are observed.

Chips lodged between contacting surfaces shall be removed before assembly.

051400 STRUCTURAL STEEL

Structural steel shall be delivered free from mill scale, rust, or pitting. Items not galvanized or protected by a shop coat of paint shall be protected from the weather until erection and painting. Contractor shall provide supplementary parts required for a complete structural steel erection even where such supplementary parts and work are not specified in detail in the Specifications or indicated on the Plans.

052000 METAL JOISTS AND FRAMING

052100 OPEN WEB STEEL JOISTS

Open web steel joists shall be manufactured and installed in accordance with the Standard Specifications of the Steel Joist Institute. Size and location of steel joists shall be as indicated on the Plans. Steel joists shall have ceiling extensions where indicated on the Plans.

Cross bridging shall be provided and shall be spaced as indicated on the Plans or shall be equal to that specified in the Standard Specifications of the Steel Joist Institute and shall be anchored to the walls as indicated on the Plans.

Cross framing members shall be installed as indicated on the Plans and as required to support the roof deck at openings.

The Contractor shall submit detailed drawings and lists. Fabrication shall be in accordance with the Recommended Code of Standard Practice of the Steel Joists Institute. The submittal shall also include design calculations for joists, cross bridging, and connections not covered in the Steel Joists Institute Standards. The design calculations for the steel joists shall be sealed by a professional engineer registered in the State where the Project is located.

055000 METAL FABRICATIONS

055300 GRATINGS

Except as otherwise specified or indicated on the Plans, grating shall be aluminum grating. Surfaces of shelf angles, rebates, and anchors in contact with concrete shall be coated in accordance with these Specifications.

Grating shall cover the areas indicated on the Plans. Unless otherwise indicated on the Plans, a grating over an opening shall cover the entire opening, The top surfaces of grating sections adjacent to each other shall be in the same plane.

Aluminum plate or angles shall be installed where required to fill openings at changes in elevation and at openings between equipment and grating. Angle stops shall be installed at ends of grating. Once installed, grating shall not slide out of the rebate or off the support. Stops shall be welded in place unless otherwise specified or indicated on the Plans.

There shall be not more than 1/8-inch clearance between the ends of the grating and the inside face of the vertical leg of the shelf angles. The horizontal bearing leg of the shelf angle shall not be less than 2 inches. Ends of grating and cutouts shall be banded. The width of the end band of the grating shall be 1/4 inch less than the depth of the grating with the top of the grating and the top edge of the banding flush. The width of cutout banding shall be full-depth of grating.

Cutouts in the grating shall be provided where required for equipment access or protrusion, including valve operators or stems, and gate frames. Edges of cutouts shall be banded with aluminum material similar to end banding.

Panel layout shall provide for installation and subsequent removal of grating around protrusions or piping. For openings 6 inches and larger grating panels shall be laid out so that the edges of two adjacent panels shall be on the center line of the opening. For openings smaller than 6 inches, the opening shall be at the edge of a single panel.

Where an area requires more than one grating section to cover the area, adjacent grating sections shall be clamped together at the 1/4 points with acceptable fasteners.

The Contractor shall submit calculations from the grating manufacturer showing that the grating will meet the load-bearing and deflection provisions of the Specifications for each size of grating and for each span. The Contractor shall, if requested by the Engineer, test under full load one section of each size of grating for each span length involved on the job, to show compliance with these Specifications. A suitable dial gauge shall be provided by the Contractor for measuring deflections. Grating shall be fabricated in units which do not exceed 50 pounds each.

055320 ALUMINUM GRATING

Aluminum grating shall be supported on aluminum shelf angles. Gratings, shelf angles, and anchors shall be of 6061-T6 or 6063-T6 aluminum alloy, except that cross bars may be of 6063-T5 aluminum alloy.

Aluminum grating shall be of such bar size and spacing that, as determined by the manufacturer, the grating shall support a uniform live load of 180 pounds per square foot on the entire area of the grating,

using an extreme fiber stress of not more than 12,000 pounds per square inch, and that the maximum deflection under this loading shall not be more than 1/240 of the clear span of the grating. The spacing of the main grating bars shall not be more than 1-1/8 inches clear between bars. Minimum depth of grating shall be 2 inches.

Grating shall be grooved Galok Aluminum I-Bar manufactured by IKG Borden Industries, Nashville, Tennessee; grooved I-Bar manufactured by Seidelhuber Metal Products, Inc., San Carlos, California; or equal.

056000 MISCELLANEOUS METALS

056100 MISCELLANEOUS ALUMINUM

Structural and other metal items fabricated from aluminum, not covered separately herein shall be fabricated in accordance with the best practices of the trade and shall be field assembled by riveting or bolting with no welding or flame cutting permitted.

056200 MISCELLANEOUS CAST IRON

Castings shall be tough, gray iron, free from cracks, holes, swells, and cold shuts. The quality shall be such that a blow from a hammer will produce an indentation on a rectangular edge of the casting without flaking the metal. Before leaving the foundry, castings shall be thoroughly cleaned and shall receive a 16-mil dry film thickness (DFT) coating of coal-tar epoxy unless otherwise specified in the Specifications or indicated on the Plans.

056210 MANHOLE FRAMES AND COVERS

Manhole frames and covers shall be made from a superior quality gray iron, conforming to the requirements of ASTM A 48, CLASS 30-B. Frames and covers shall have horizontal and vertical bearing surfaces machined to fit neatly, and the cover shall bear firmly in the frame without rocking and shall be easily removable. Frames and covers shall be heavy duty traffic type and shall have a combined set weight of at least 301 pounds. Frames and covers shall be delivered to the site unpainted.

Frames shall have a clear inside opening of 23 inches diameter and shall be of the bottom flange type. Frame height shall be approximately 6 inches and bottom flange outside diameter shall be approximately 34 inches.

Manhole covers shall be set at elevations as specified on the Plans. All manhole covers shall be D&L model C-2107 or approved equal.

056400 MISCELLANEOUS STRUCTURAL STEEL

Miscellaneous steel items not specified herein shall be as indicated on the Plans or specified elsewhere in these Specifications and shall be fabricated and installed in accordance with the best practices of the trade.

057000 ARCHITECTURAL AND MISCELLANEOUS SHEET METAL

Sheet metal flashing, counterflashing, fascia, gravel stops, and other roofing accessories shall be in accordance with these Specifications.

Surfaces to which sheet metal is to be applied shall be even, smooth, sound, thoroughly clean and dry, and free from defects that might affect the application. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed in accordance with these Specifications. Accessories or other items essential to the completeness of this sheet metal installation, though not specifically indicated on the Plans or specified, shall also be provided. Nails, screws, and bolts shall be of the types best suited for the intended purpose and shall be of a composition that will not support galvanic action in the installation. Sheet metal which abuts into adjacent material shall be installed as indicated on the Plans. Where not indicated on the Plans, the installation shall be executed in the best manner meeting the standards of the trade.

Sheet metal items not covered elsewhere shall be as indicated on the Plans and as required to provide a watertight installation. Formed sheet metal for metal covered work shall accurately reproduce the detail and design indicated on the Plans; profiles, bends, and intersections shall be sharp, even, and true.

057100 ALUMINUM SHEET METAL WORK

Except as otherwise specified or indicated on the Plans, sheet aluminum shall be alloy 5005-H14 conforming to the requirements of ASTM B 209 and shall be not less than 0.032-inch in thickness. Extruded aluminum shall be 6063-T4, conforming to the requirements of ASTM B 221.

*** END OF DIVISION 5***

DIVISION 6

WOOD AND PLASTICS

060000 GENERAL

The carpentry work, materials, and accessories shall be as indicated on the Plans and as described in these Specifications. Carpentry work, where not indicated or specified in detail, shall be in accordance with normal good practice and applicable requirements of the Uniform Building Code and local codes.

Notching, coping, and metering of meeting members shall be done in such a manner that the meeting members shall have full bearing and without overcutting or undercutting.

Unless otherwise specified, lumber shall be seasoned or kiln-dried and shall contain not more than the moisture hereinafter specified.

Where nailing is not specified, Table 25-P of the Uniform Building Code shall be followed. Box nails shall not be used. Bolts and other fastenings shall be as indicated on the Plans, or if not so indicated, shall be in accordance with the Uniform Building Code. All nails and fastenings which are exposed to the weather or on the exterior of buildings shall be hot-dip galvanized or Series 300 stainless steel.

The Contractor shall be responsible for all measurements, locations and elevations, fitting of all work, and accommodation of other trades. Before commencing work, the Contractor shall compare all drawings and report any discrepancies to the Engineer for clarification or adjustment.

Materials shall be covered to protect from damage and moisture. Lumber shall be stacked to permit good air drying with separators at each layer and between soil and the first layer.

060100 ROUGH CARPENTRY

Rough carpentry shall essentially refer to carpentry work and materials that are not normally exposed to view and shall include all necessary metal items and connectors related to installation and erection as specified herein and shown on the Plans.

Lumber grades shall be in accordance with the following reference standards:

- A. DOUGLAS FIR AND HEMLOCK: West Coast Lumber Inspection Bureau (WCLIB), Standard Grading and Dressing Rule No. 16; Western Wood Products Association (WWPA) Grading Rules; National Grading Rule for Dimension Lumber, PS20-70; Uniform Building Code Standards 25-1, 25-3, and 25-4.
- B. REDWOOD: Standard Specification for grades of California Redwood Lumber; Redwood Inspection Service.
- C. PLYWOOD: U.S. Product Standard "PS 1" for Softwood Plywood; Uniform Building Code Standard 25-9.
- D. PRESERVATIVE PRESSURE TREATMENT: Federal Specification TT-W-572I(2); Uniform Building Code Standard 25-12.

060120 MATERIALS

060121 WOOD

Lumber shall be seasoned or kiln-dried and shall contain not more than 19 percent moisture. All lumber shall be S4S unless noted otherwise. Lumber shall be free of bow, warp, or twist. Pieces with serious defects will be discarded regardless of grading.

Each piece of lumber shall be stamped with grade, species, and size.

Each panel of soft plywood shall be identified with the appropriate DFPA grade-trademark of the American Plywood Association and shall meet the requirements of the latest edition of U.S. Product Standard PS-1 for Softwood Plywood-Construction and Industrial and Uniform Building Code Standard 25-9.

Lumber 2 inches, 3 inches, and 4 inches thick shall be graded in accordance with the National Grading Rule for Dimension Lumber, PS 20-70 or Uniform Building Code Standard 25-1, and shall be identified by grade name and species only without reference to paragraph numbers. Lumber 6 inches and larger shall be graded under provisions of WWPA or Uniform Building Code 25-4, and shall be identified by grade, name species, and size. Equivalent members graded by WCLIB or Uniform Building Code Standard 25-3 will be accepted unless specifically excluded.

Unless otherwise specified, all beams, joists, and rafters shall have the following minimum values for design:

Modules of Elasticity	= E =	1,300,000 psi
Fiber Stress in Bending	= F _b =	1,200 psi

The following minimum lumber requirements apply for all framing and sheathing:

<u>Classification</u>	<u>Size</u>	<u>Species and Minimum Grade</u>
Studs	2x3, 2x4	DF-L No. 2
	2x6, 2x8	DF-L No. 2
Roof Joists	2x6 thru 2x14	DF-L No. 2
Floor Joists and Planking	2x6 thru 2x14	DF-L No. 2
Headers, Beams, and Stringers	6x6 or 8x14	DF-L No. 1 (WWPA Section 70-11)
	4x4 or 4x14	DF-L No. 1
Posts and Timbers	6x6 and large	DF-L No. 1
Boards	1" thick	DF-L Construction

Framing Lumber	all sizes	DF-L No. 1
Blocking and Bridging	2x4, 2x6	DF-L Construction
Miscellaneous	all sizes	DF-L No. 2

DF-L = Douglas Fir-Larch (North) Grouping

Species shall be as specified or any species combination allowed by the grading rules.

Sills, cants, nailers for fascia and gravel stops at the edges of the roof or at roof expansion joints shall be preservative pressure-treated Construction Grade Douglas Fir. Lumber shall be full 2 inches thick when used with roof insulation but widths may be nominal.

Redwood for baffles and stop logs shall be Construction Heart Grade.

All wood members in contact with concrete or masonry shall be pressure treated with wood preservative.

Where indicated on the Plans the lumber for rough carpentry work shall be treated with a flame retardant.

Plywood with edges or surfaces permanently exposed to the weather shall be exterior type with exterior glue, Grade A-C. Plywood roof sheathing shall be APA ½-inch C-D, Grade 24-0 with exterior glue. Plywood sheathing exposed at overhangs shall be exterior type plywood with exterior glue, Grade A-C or better. Miscellaneous plywood shall be exterior type Douglas Fir plywood of the thickness indicated on the Plans, Grade A-C, or as indicated on the Plans. Plywood shall be Group 1.

060122 FASTENERS

Nails shall conform to Federal Specification FF-N-105B and shall be common wire nails or spikes.

Bolts, nuts, and studs shall conform to requirements of Federal Specifications FF-B-584E, FF-S-1362, and FF-B-575C.

Lag bolts shall conform to Federal Specification FF-B-561C and be galvanized.

Wood screws shall conform to Federal Specification FF-S-111D.

All nails, screws, bolts, and plates exposed to weather shall be hot-dip galvanized or Series 300 stainless steel.

Power-driven pins to be installed in concrete or steel shall be heat-treated steel alloy. Pins that are not sufficiently corrosion-resistant for the conditions to which they are to be exposed shall be protected in an acceptable manner. Pins shall have capped or threaded heads capable of transmitting the loads that shanks are required to support. Pins connected to steel shall have longitudinal serrations around the circumference of the shank.

060123 MISCELLANEOUS HARDWARE

Clamps, expansion bolts, expansion screws, joist hangers, anchors, and plates shall be standard make of proper size and strength to adequately fasten, support, and maintain members in place. All exposed hardware shall be galvanized.

060124 WOOD PRESERVATIVE

Wood preservative shall be one of the following materials subject to the approval of the Engineer: Tanalith (Wolman salts), ammoniacal copper arsenite (Chemonite), chromated zinc arsenate (Boliden salt), and chromated copper arsenate (Green salt or Erdalith) or 5 percent pentachlorophenol in mineral spirits conforming to Recommended Practice of American Wood Preserver's Association (AWPA) P8 and P9, and Federal Specification TT-W-572B, as amended. The quantity retained per cubic foot shall be not less than that specified in AWPA C2 for the service conditions. The method of application shall be in conformance with AWPA C1 and C2.

The solution shall be nonstaining, non-blooming, and shall not form crystals or leave a flame-supporting residue, and shall completely dry within 5 days. Materials detrimental to other finishes shall not be used.

060125 FIRE RETARDANT TREATMENT

Fire retardant treatment shall be in accordance with American Wood Preservers Institute (AWPA) Standards C1 for all timber products preservative treatment, C20 for structural lumber and C27 for plywood. Wood shall be marked with UL Classified Fire rating system.

060130 WORKMANSHIP

The Work shall be performed in accordance with the standard practices of the trade, the Uniform Building Code, and the following.

Lumber shall be accurately cut, fitted, and framed. Walls shall be plumb and true to line. Nailing blocks and backing necessary for the attachment of ground, trim, fixtures, and miscellaneous items shall be placed and required cutting, furring, and backing for plumbing and heating pipes, fixtures, and electrical work, shall be performed.

Plates on top of masonry walls shall be level and in the same plane. Plates shall be anchored to masonry or concrete with bolts of the size and spacing shown on the Plans, and there shall be an anchor bolt within 6 inches of the end of each member. Cement grouting shall be used, if necessary, to ensure full bedding and leveling of the plates.

All stud walls and partitions where required by governing codes or with air space greater than 7 feet, shall have a continuous row of blocking or fire stopping which shall form a complete and effective separation for the entire width of the wall or partition. Firestop blocking or blocking for plumbing fixtures, casework, electrical equipment, and other fixtures shall be located so that there will be no concealed air spaces greater than 7 feet in horizontal or vertical dimension.

Fire stops blocking shall be not less than 2 inches nominal thickness and of the same width as studs. Strips of full-thickness rock wool shall be installed around pipes and installed to fill all other openings in fire stops.

Walls and partitions shall be framed with studs of sizes indicated, on not greater than 16-inch centers. Double studs shall be provided at openings and triple studs shall be provided at corners. Double plates shall be provided at ceilings and at heads of openings. Plates shall be arranged to form continuous horizontal ties. Single plates shall be spliced and ends staggered on double plates. Where not indicated on the Plans, lintels up to 48 inches wide shall be two pieces of 2-inch by 6-inch, and openings for 48

inches to 72 inches wide shall be two pieces of 2-inch by 8-inch on edge. Openings for large pipes and ducts and for receiving recessed work in partitions shall be framed without cutting structural members.

Two layers of 15-pound waterproof building paper shall be provided under sills and members in contact with concrete or masonry. Sills shall be secured as indicated on the Plans. If not indicated, sills shall be anchored with ½-inch diameter by 12-inch long bolts with standard hooks at 4-foot centers.

All wood within metal framed partitions and furring shall be fire retardant pressure treated; blocking shall be provided for attaching paneling, trim, and similar items at metal framing.

Cutting of wood beams or joists and plates in bearing walls for passage of pipes will not be acceptable. Cutting of wood beams or joists not indicated on the Plans shall be limited to cuts or bored holes not deeper than 1/5 the beam depth from the top and shall be subject to approval by the Engineer.

Pieces of lumber complying with these Specifications and used for joists shall be so fabricated so that no knot or other defect occurs within 12 inches of the bearing notch.

All sleepers for mechanical equipment and curb openings shall be coordinated with appropriate trades or suppliers for locations and sizes.

Nail holes shall be subdrilled where required to avoid splitting. All split pieces of material shall be removed and replaced.

Screws and lag bolts shall have holes subdrilled and shall be screwed into place. Hammered wood screws and lag screws will be rejected and cause replacement of members involved.

Bolts shall have drilled holes 1/32-inch larger than bolt shank unless noted otherwise. All final bolting shall be done after the structural members have been properly aligned.

Square plates or malleable iron washers shall be provided under heads and nuts of all bolts, lag bolts, and screws bearing on wood. Bolts shall be aligned where exposed. Power nailing will be permitted where nails are as specified provided wood members are not marred or damaged.

060230 WORKMANSHIP

The Contractor shall verify all measurements, locations, and elevations, and shall insure accurate fitting of all work and accommodation of other trades.

Construction for exposed structural members shall be in accordance with the Uniform Building Code and local codes. Millwork shall be custom grade in accordance with the Woodwork Institute of California and equivalent Architectural Woodwork Institute.

Work shall be plumb and level with tight joints and securely fastened. Cutting and fitting required for other trades shall be done. Trim shall be nailed as required for thickness of member and substrate: minimum 8d at 16-inch for 1-inch material and 12d at 16-inch for 2-inch material. Nails shall be blinded where possible, and finish nails shall be used where exposed.

Edges shall be eased. Exposed surfaces and edges shall be sanded as required.

060300 WOOD TRUSSES

060310 GENERAL

060311 SUMMARY

Section includes: wood trusses, including bridging, temporary and permanent bracing, associated components, and accessories.

060312 REFERENCES

American Institute of Timber Construction (AITC).

National Forest Productions Associations (NFPA) - National Design Specifications.

American Society for Testing and Materials (ASTM):

1. A 446 - Specification for Steel Sheet, Zinc Coated (Galvanized by the Hot-Dip Process, Structural (Physical Quality).
2. A 525 - Specification for General Requirements for steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

060313 SUBMITTALS

Shop Drawings: For each type and size truss, include:

1. Species and grades of lumber used.
2. Design loadings and allowable unit stress increase.
3. Force analysis of each member.
4. Pitch, span, and spacing trusses.
5. Metal connector, gauges, sizes, and name of manufacturer.
6. Bearing and anchorage details.
7. Truss supports.
8. Camber.
9. Permanent bracing and bridging.

Seal and signature of design professional registered and qualified to design trusses in state where Project is located.

1. Product Data.
2. Handling and erection instructions.
3. Design Data.
4. Certificates.

060314 QUALITY ASSURANCE

Manufacturer Qualifications. Manufacturer of proposed product for minimum 5 years with satisfactory performance record.

Design and fabricate wood trusses in accordance with:

1. “National Design Specifications for Stress-grade Lumber and its Fastenings” by AITCH.
2. “Design Specifications for Light Metal Plate Connected Wood Trusses” by Truss Plate Institute.

Lumber shall bear grade mark stamp of recognized grading association or licensed lumber inspection agency. Fabricate trusses and other roof structural components in properly equipped manufacturing facility of permanent nature. Employ only experienced workmen, using precision cutting and truss fabricating equipment, under direct supervision of qualified foreman. Fabricate trusses under strict rules of inspection and quality control. Erector Qualifications: Erector of products similar to specified products on a minimum of 5 projects of similar scope as Project with satisfactory performance record.

060315 DELIVERY, STORAGE, AND HANDLING

Handle fabricated trusses and subassemblies with care so trusses are not subject to damage. When trusses are stockpiled or stored prior to erection, set trusses in vertical positions, resting upon temporary bearing supports and braced so trusses will not be subject to unusual bending or tip over. Provide means for adequate distribution of concentrated loads so carrying capacity of trusses are not exceeded.

060320 WOOD TRUSSES

060321 LUMBER

Species and Grades: In accordance with stress ratings for species and grades in grading rules of appropriate lumber association or as listed in referenced quality assurance standards, unless otherwise indicated on the Drawings.

Moisture Content: Within limits as stipulated in quality assurance standards, but not exceeding 19 percent or less than 7 percent at time of fabrication.

Nominal Sizes: As indicated on the Shop Drawings.

060330 INSTALLATION

Set and secure wood trusses level, plumb, and in correct locations. Install erection bracing to hold trusses true and plumb, and in correct locations. Install erection bracing to hold trusses true and plumb and in safe condition until permanent truss bracing and bridging can be solidly fastened in place. Keep horizontal bending of trusses to minimum. Ensure truss ends have sufficient bearing area. Install permanent bracing and bridging, and permanently fasten components before application of loads. Connect continuous lines of 2-by-4 bridging to trusses at web or chord members during erection stage. Provide one line along top and one line along bottom chord. Erect trusses with top and bottom chords in true vertical alignment. Align top chords of trusses parallel to each other and straight with no point in plane on top chords more than 3/8 inch out of true horizontal line. Do not cut or alter truss members.

065000 MISCELLANEOUS PLASTICS AND FIBERGLASS

The Contractor shall furnish and install miscellaneous plastic and fiberglass items as indicated on the Plans and as specified herein.

065001 SUBMITTALS

Shop drawings shall show dimensions and composition of materials of construction and other details necessary to ascertain that the fiberglass or plastic item meets the specified requirements.

*** END OF DIVISION 6 ***

DIVISION 7

THERMAL AND MOISTURE PROTECTION

070000 GENERAL

Specification requirements referred to for various materials are minimum requirements. Materials furnished shall be suitable for use under the year-round local climatic conditions of the site at which they are installed.

070200 DAMP PROOFING

070210 BITUMINOUS DAMPPROOFING

A Bituminous damp proofing system shall be applied to all exterior buried wall surfaces of the pump station/ vault.

Bituminous coating used as damp proofing shall be a solvent type asphalt coating; Celotex Asphalt Foundation Coating manufactured by the Celotex Corporation, Tampa, Florida; Topgard F manufactured by Johns-Manville, Denver, Colorado; or equal.

The Contractor shall examine all surfaces to be damp proofed before starting work. Application of damp proofing shall imply acceptance of the conditions.

All surfaces to be damp proofed shall be coated with concrete primer, and shall be clean, dry, reasonably smooth, free of dust, dirt, voids, cracks or sharp projections. Damp proofing must be applied only to dry surfaces, and shall not be applied when temperatures are 40 degrees F or lower or when rain is forecast for the 24 hours following application.

All surfaces to receive the bituminous coating shall be completely covered with 2 coats applied by brush or spray. Apply each coat evenly so that all surfaces have a uniform black appearance. Apply the second coat at right angles to the first, allowing not less than 24 hours between coats. Rate of application shall conform to manufacturer's recommendations with a minimum rate of not less than 1 gallon per square per coat. Backfill shall be completed within 7 days. Damp proofing shall be held down 6 inches maximum from finished grade; coating exposed to view will not be accepted.

070230 SURFACE SEALANT SYSTEM

The surface deck of the sidewalks, and exposed concrete slabs shall be coated with surface sealant system specified in DIVISION 3 - CONCRETE.

070300 BUILDING INSULATION

Buildings shall be insulated as indicated on the Plans or specified in the following Specifications.

Insulation shall be loose-fill cellulose insulation and have an R-value of 30. Installation shall comply with insulation manufacturer's written instructions applicable to products, applications and applicable codes. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time. Install insulation with manufacturer's R-value label exposed after insulation is installed.

Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value. For loose-Fill Insulation: Apply in accordance with ASTM C1015 and manufacturer's written instructions. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively. For cellulosic-fiber loose-fill insulation, comply with CIMA's Technical Bulletin #2, "Standard Practice for Installing Cellulose Building Insulation."

070600 ROOFING

070610 GENERAL

070611 SUMMARY

Section Includes: Preformed metal roofing, fascia, and associated accessories.

070612 REFERENCES

1. ASTM 1402.86 - Specification for Aluminum Siding, Soffit, and Fascia.
2. ASTM D-2626 - Specification for Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing.
3. American Iron & Steel Institute (AISI) Specification for the Design of Cold Formed Steel Structural Members.
4. ASTM A-653/A-653M & ASTM A924 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
5. ASTM A-755/A-755M Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Pre-painted by the Coil-Coating Process for Exterior Exposed Building Products
6. ASTM E-1680-95 (Air Infiltration Test)
7. ASTM E-1646-95 (Water Penetration Test)
8. ASTM E-1592
9. Spec Data Sheet - Galvalume Sheet Metal by Bethlehem Corp.
10. SMACNA - Architectural Sheet Metal Manual.
11. Building Materials Directory - Underwriter's Laboratories, Test Procedure 580.

070613 SUBMITTALS

Submit following:

1. Shop Drawings: Include thicknesses and dimensions of parts, fastening and anchoring methods, details and locations of seams, joints and other provisions for thermal movement. Show plans and elevations at minimum scale of 1/4 inch to one foot, and details at minimum scale of 3 inches to one foot. Also, submit details showing joints, trim, flashing, accessories, weatherproofing, terminations, and penetrations of metal work.
2. Product Data: Submit data on metal types, finishes, and characteristics. Include standard color and finish options.
3. Samples: Include 8-inch square samples of color and finish on specified substrate.
4. Manufacturer's Installation Instructions.
5. Certificates: Manufacturer's approval of Installer and Shop Drawings.

6. Submit results indicating compliance with minimum requirements of the following performance tests:
 - a. Air Infiltration ASTM E-1680-95
 - b. Water Infiltration ASTM E-1646-95
 - c. Wind Uplift - U.L.90
7. Submit calculations with registered engineer seal, verifying roof panel and attachment method resists wind pressures imposed on it pursuant to applicable building codes.
8. Operation and Maintenance Data.
9. Warranty.

071614 QUALITY ASSURANCE

Installer Qualifications: Manufacturer approved installer of products similar to specified products on minimum 5 projects of similar scope as project with satisfactory performance record.

Perform Work in accordance with SMACNA Architectural Sheet Metal Manual requirements, except as otherwise noted.

Perform Work in accordance with State of Utah standards

Exposed sheet metal material used for roofing, including roofing panels, flashings, closers, and other trim shall be product of one manufacturer.

Other materials shall be products approved or recommended by roofing system manufacturer.

070615 DELIVERY, STORAGE, AND HANDLING

Deliver, store, and handle products in accordance with manufacturer's recommendations. Stack material to prevent twisting, bending, abrasion, and to provide ventilation. Slope metal sheets to ensure drainage. Prevent contact with materials causing discoloration or staining.

070616 WARRANTY

Paint finish shall have a twenty-year guarantee against cracking, peeling and fade (not to exceed 5 N.B.S. units). Galvalume material shall have a twenty-year guarantee against failure due to corrosion, rupture or perforation. Applicator shall furnish guarantee covering watertightness of the roofing system for the period of five (5) years from the date of substantial completion, limited to ordinary wear and tear by elements or defects due to faulty materials and workmanship.

070620 METAL ROOFING SYSTEM

070622 PREFORMED METAL ROOFING

System: Standing Seam Panel sheet steel roofing system, including fascia, flashing, and sealants. 1.75" high vertical legs spacing: 16 inches on center, color as selected by owner. Basis of design: Western States Metal Roofing Western Lock Standing Seam or equal.

Material: Zinc-coated (galvanized) steel sheet, 0.025-inch nominal thickness (24 gauge). Provide 2-coat fluoropolymer exterior finish. Clips: Fixed, metallic coated steel. Joint Type: As standard with

manufacturer. Panel Coverage: 16 inches. Panel Height: 1.75 inches.

Performance and Design Criteria

Hydrostatic Head Resistance: No water penetration when tested according to ASTM E2140.

Wind Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind uplift resistance and have UL 90 uplift rating.

FMG Listing: Provide metal roof panels and component materials that comply with requirements in FMG 4471 as part of panel roofing system and that are listed in FMG Approval Guide for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.

Fire/Windstorm Classification: Class 1A-90. Hail Resistance: MH.

General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips inside laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

Substrate: Examine plywood or metal deck to ensure proper attachment to framing. Inspect roof deck to verify deck is clean and smooth, free of depressions, waves or projections, level to +/- 1/4" in 20', and properly sloped to eaves. Verify roof openings, curbs, pipes, sleeves, ducts or vents through roof are solidly set and sealed, cant strips and reglets in place, and nailing strips located. Verify deck is dry and free of snow or ice. Joints in wood deck to be solidly supported and nailed.

Substrate-Board Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FMG 4470, designed for fastening substrate board to substrate.

Underlayment Materials: Tyvec Protec 200 or equal. Grace Ultra-Ice and Water Shield or equal.

Roof Panel Accessories: Provide components approved by roof panel manufacturer and as required for complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.

Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels. **Closure Strips:** Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or pre-molded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction. **Backing Plates:** Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

Flashing and Trim: Formed from same material as roof panels, pre-painted with coil coating, minimum 0.018 inch thick. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.

Gutters: Formed from same material roof panels. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, of size and metal thickness according to SMACNA Architectural Sheet Metal Manual. Furnish gutter supports spaced maximum of 36 inches on center, fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to color selected by owner.

Downspouts: Formed from same material as roof panels. Fabricate in 10-foot-long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA Architectural Sheet Metal Manual. Finish downspouts to color selected by owner.

Underlayment: Verify #30 unperforated asphalt saturated roofing felt underlayment has been installed over solid sheathing and fastened in place. One (1) layer of #30 asphalt roofing felt paper for roof slopes of 3:12 and up, two (2) layers for roof slopes of 1:12 - 3:12 in moderate climates. Grace Ice & Water Shield underlayment to be used on all curved applications and on low (less than 1:12) slope or complex roofs, all valleys, and within 4' of all edges. Ensure felt installed horizontally, starting at eave to ridge with a 6" minimum overlap and 18" endlaps. Ensure that all nail heads are totally flush with the substrate. Broom clean deck surfaces under eave protection and underlayment.

Install starter and edge strips, and cleats before starting installation.

070623 EXPOSED COMPONENTS

Sheet Steel: Prefinished Metal shall be Hot-Dipped Galvanized - ASTM A446-85 Grade C G90 Coating A525-86 24 Gauge core steel or prefinished 24 Gauge Galvalume - ASTM 792-86 AZ-55. Unfinished Metal shall be Grade C Galvalume ASTM A792-86, AZ 55, "Satin Finish". Strippable film shall be applied to the top side of the painted coil to protect the finish during fabrication, shipping and field handling. This strippable film must be removed before installation.

Finish: Finish shall be full strength Kynar 500 Fluoropolymer coating, applied by the manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.70 to 0.90 mil over 0.25 to 0.35 mil prime coat, to provide a total dry film thickness of 0.95 to 1.25 mil. Bottom side shall be coated with primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesion, flexibility, and longevity as specified by the Kynar 500 finish supplier.

Color: Finish color to be determined by owner.

070633.3 STANDING SEAM ROOFING INSTALLATION

Comply with manufacturers standard instructions and conform to standards set forth in the Architectural Sheet Metal Manual published by SMACNA, in order to achieve a watertight installation. Install panels in such a manner that horizontal lines are true and level and vertical lines are plumb. Install starter and edge trim before installing roof panels. Remove protective strippable film prior to installation of roof panels. Attach panels using manufacturer's standard clips and fasteners, spaced in accordance with approved shop drawings. Install sealants for preformed roofing panels as approved on shop drawings. Do not allow panels or trim to come into contact with dissimilar materials. Do not allow traffic on completed roof. If required, provide cushioned walk boards. Protect installed roof panels and trim from damage caused by adjacent construction until completion of installation. Remove and replace any panels or components which are damaged beyond successful repair. Seal joints where necessary for watertightness.

Completed roof shall be watertight. Exposed surfaces shall be free of dents, scratches, abrasions, stains, and other visible defects.

070633.4 SNOW RESTRAINTS

Shall be placed over doorways only. Extend to 6” on both sides of doorway lay length.

PART 1 – GENERAL

1.1 SUMMARY

A. WORK INCLUDES

1. Coordinate with installation of roof to assure proper placement of snow guards.
2. Provide appropriate snow guard and fasteners for roof system

1.2 SYSTEM DESCRIPTION

- #### A. COMPONENTS: Fence style snow guard and clamp-to-seam attachment blocks.

1.3 QUALITY ASSURANCE

- #### A. Installer to be experienced in installation of specified roofing material and snow guards for not less than 5 years in the area of the project.

1.4 DELIVERY / STORAGE / HANDLING

- #### A. Inspect material upon delivery and order replacements for any missing or defective items. Keep material dry, covered and off the ground until installed.

PART 2 – EXECUTION

3.1 EXAMINATION

A. Substrate

1. Inspect structure on which the brackets are to be installed and verify it will withstand any additional loading that it may incur. Notify general contractor of any deficiencies before installing.
2. Verify roofing material has been installed correctly prior to installing standing seam snow guard.

3.2 INSTALLATION

- #### A. Comply with architectural drawings and snow guard manufacturer’s recommendations for location of system. Comply with manufacturer's written installation instructions for installation and layout.

070700 PREFORMED METAL SOFFITS

070710 GENERAL

070711 SUMMARY

Section Includes: Pre-formed metal soffits, and associated accessories.

1. Interior Soffits.
2. Exterior Soffits.

070712 REFERENCES

American Architectural Manufacturers Association (AAMA):

1. Specification 1402.86 - Specification for Aluminum Siding, Soffit and Fascia.

070713 SUBMITTALS

Submit the following:

1. Shop Drawings: Include thicknesses and dimensions of parts, fastening and anchoring methods, details and locations of seams, joints and other provisions for thermal movement. Show plans and elevations at minimum scale of 1/4 inch to one foot, and details at minimum scale of 3 inches to one foot.
2. Product Data: Include standard color and finish options.
3. Samples: Include 8-inch square samples of color and finish on specified substrate.
4. Manufacturer's Installation Instructions.
5. Certificates: Manufacturer's approval of Installer and Shop Drawings.
6. Warranty.

070714 QUALITY ASSURANCE

Installer Qualifications: Manufacturer approved installer of products similar to specified products on minimum 5 projects of similar scope as Project with satisfactory performance record.

Exposed sheet metal material used for soffit panels, flashings, closers, and other trim shall be product of one manufacturer.

Other materials shall be products approved or recommended by soffit system manufacturer.

070715 DELIVERY, STORAGE, AND HANDLING

Deliver, store, and handle products in accordance with manufacturer's recommendations.

070716 WARRANTY

Provide manufacturer's nonprorated lifetime warranty on materials and replacement labor.

070720 METAL SOFFIT

070721 PREFORMED INTERIOR METAL SOFFITS

Manufacturer: One of the following or equal:

1. Alcan Building Products.

Material: D6 Vented Soffit, aluminum sheet (minimum 0.019 inch except for incidental components).

Fabrication: Formed aluminum panels and related trim to meet or exceed requirements of AAMA Specification 1402.86. with 3/8-inch V-Groove.

Type: Ventilated panels.

Finish: Super-Gard, consisting of PVC plasticol coating, or equal

Finish Color: As selected from manufacturer's standard colors.
Accessories: Fabricated to match soffit panels.

070722 PREFORMED EXTERIOR METAL SOFFITS

Preformed Metal Soffits: One of the following or equal:

1. Architectural Engineering Products (AEP/SPAN) Co., Dallas, TX.
2. Alcoa Building Products.
3. ASC Pacific, Inc., Tacoma, WA.
4. Berridge Manufacturing Co., Houston, TX.
5. Foremost Manufacturing Co., Southfield, MI.
6. Peterson Aluminum Corporation, Elk Grove Village, IL.

Manufacturer: One of the following or equal:

1. Alcoa Building Products.

Material: 3005-H19, aluminum sheet, minimum 0.019 inch except for incidental components.

Fabrication: Formed aluminum panels and related trim to meet or exceed requirements of AAMA Specification 1402.86. with 3/8-inch V-Groove.

Types: Ventilated and non-ventilated panels.

Finish: Alupalure 2000, consisting of corrosion inhibiting primer and baked on, high performance, acrylic topcoat.

Finish Color: As selected from manufacturer's standard colors.

Accessories: Fabricated to match soffit panels.

070730 INSTALLATION

070731 SOFFITS

Install soffit system in accordance with manufacturer's recommendations. Contractor shall take care when installing soffit panels and trim to not puncture fastening means completely thru the metal. Individual interlocking panels should be fastened at each end of the leading edge at a minimum. Install trim at each end of soffit panel. Miter all corners.

Exercise care in placing aluminum in contact with metals or materials not compatible with aluminum. Isolate dissimilar metals with neoprene gaskets. Install ventilated panel every fourth panel. Finished soffit shall be accurately aligned and free of dents, scratches, or other defects.

*** END OF DIVISION 7 ***

DIVISION 8

DOORS, WINDOWS, AND HARDWARE

080000 GENERAL

These Specifications cover the furnishing and installing of doors, windows, hardware, and glazing for doors and windows.

Doors, door frames, windows, and window frames shall be fabricated and installed in a workmanlike manner. Doors, windows, and hardware shall be adjusted so that operation will be smooth, free, and easy, and with no binding in the hardware, or between doors and frames, or windows and frames. Doors and windows shall be set plumb, square, and level at their proper elevation and in their proper plane. Hardware shall be adjusted to operate smoothly, freely, and properly. Doors, windows, and frames shall be protected during shipment and storage to prevent warping, bending, or corrosion.

Doors and frames shall be prepared and reinforced for hinges, locksets, strikes, closers, and other items as required. Doorknobs shall be 40 inches above the floor to the center line of the knob. Preparations in pressed steel frames for hinges, strikes, flush bolts, and other items shall be protected with dust boxes.

Door sizes, leaf types, door frames, and window type and size shall be as indicated scheduled on the Plans. Aluminum shall be insulated as specified under DIVISION 5, METALS. Shop drawings shall be submitted to the Engineer for review.

080200 HOLLOW METAL DOOR AND STEEL FRAMES

080201 GENERAL

Steel doors, indicated on the Plans, and their pressed steel frames shall be hollow steel doors as manufactured by Overly Manufacturing Company, Los Angeles, California, or equal, and as detailed on the Plans and specified herein.

080210 MATERIALS

Doors, transom panels, and frames exposed in whole or in part to the weather, doors located in unheated spaces, or fire rated doors shall be generally specified herein and fabricated entirely from galvanized steel sheet conforming to ASTM A 525, with 1.25-ounce coating. Internal stiffeners and anchors may be of plain sheet steel. Exterior doors shall have perimeter weatherproofing seal.

080211 DOORS

Hollow metal doors shall be 1-3/4-inch thick flush type, constructed of two steel sheets of not less than 16-gauge formed and welded for flush pan assembly, with internal 20-gauge formed and welded for flush pan assembly, with internal 20-gauge vertical reinforcing channels spaced not over 8 inches on centers the full height of the door. Reinforcing channels shall be uniformly spot welded to mated parts. Continuous 18-gauge stiffener channels shall be welded to faceplates at top and bottom of all doors. Filler channels shall be provided at the top of exterior doors and also at the bottom of doors with thresholds to provide flush closure. All interior void spaces shall be completely filled with not less than 3-pound density rock wool. There shall be no visible joints on the face of the doors.

080213 DOOR REINFORCEMENT

Concealed sheet or bar steel reinforcing shall be provided for mortise type hardware. Reinforcing shall not be less than the following: 9-gauge for butts, 12-gauge for locksets, and 14-gauge for surface applied hardware. Reinforcing shall be drilled and tapped to template requirements. Concealed reinforcing shall be provided for closers.

080215 FRAMES FOR METAL

Frames for hollow metal doors shall be pressed steel, shall be constructed of not less than 14-gauge steel, and shall be of the shape indicated on the Plans and as required to fit the various wall construction. Frames shall be of welded unit construction, assembled and welded in the shop. Welding shall be to a hairline joint with all exposed beads ground smooth. Concealed reinforcing of the frames for mortise hardware shall be not less than the following: 3/16-inch for butts, 12-gauge for lock strike, 14-gauge for surface applied items; and 18-gauge plaster guards over mortised hardware reinforcement. Frames shall be mortised drilled and tapped to template requirements. Lock reinforcing units shall be supplied by finish hardware supplier. Frames in concrete shall be held in place by grout poured in keyways provided at all heads and jambs. Frame corners shall be welded full length of joint, including integral stop. Anchors welded into frame shall be provided for concealed attachment to wall construction at 30-inch maximum spacing. Contractor shall provide 14-gauge floor anchors for two bolts to structure and mortar-tight covers behind cutouts in frames to be grouted. Frames to be anchored from face side shall have access to anchor bolts concealed by separate stop secured by countersunk oval Phillips, or equal, head screws at 18-inch maximum spacing. Loose stops shall be 18-gauge.

After shop assembly, doors and frames shall be cleaned thoroughly, ground smooth, and all seams along the edges of the door shall be filled flush with mineral filler. All doors and frames shall be bonderized and given one shop coat of rust inhibitive primer.

Painting of doors shall be as specified in DIVISION 9.

080400 ROLL-UP OVERHEAD DOOR

The overhead roll-up door of the size described in the plans shall be installed at the locations shown on the plans. The doors shall be a commercial grade insulated sectional steel overhead door. The doors shall be fabricated of 22 gauge galvanized steel with the back slat of 24 gauge galvanized steel. Doors shall be filled with CFC-free foamed-in-place polyurethane insulation achieving an R-Value of 17.5. The door shall be provided with an inside friction lock mechanism, 14 gauge galvanized hinges, steel ball bearing rollers, galvanized track, full bulb-type bottom weatherstrip and full perimeter weatherseal, prepainted steel end stiles, and 24 gauge front panel.

The door finish shall be galvanized steel. Slats and hood shall be galvanized steel in accordance with ASTM A 653 and receive rust-inhibitive, roll coating process, including 0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on polyester top coat. Non-galvanized exposed ferrous surfaces shall receive one coat of rust-inhibitive primer. Color shall be selected by the owner to match the existing building.

Weatherseals will have a vinyl bottom seal and internal hood seals. The bottom bar will be a two prime painted stainless steel angles, with a minimum thickness of 1/8" bolted back to back to reinforce curtain in the guides.

Provide three guides of galvanized steel angles with minimum thickness of 3/16". Guides shall be

weatherstripped with a vinyl weather seal at each jamb, on the exterior curtain side. Brackets will be galvanized steel to support counterbalance, curtain and hood.

Doors shall be counterbalanced by a helical torsion spring type designed for standard 20,000 cycle life design. Counterbalance shall be housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to 0.03" per foot of span. Counterbalance shall be adjustable by means of an adjusting tension wheel.

The hood is to be galvanized steel, 24 gauge hood with intermediate supports as required. Provide with internal hood baffle weatherseal.

The door will be able to operate by electric motor and manual operation. The manual operation will be operated by chain hoist. Provide UL listed 110 V, single phase electric operator, sized as recommended by manufacturer. The electric motor will have a pneumatic sensing edge. One interior push button (open, close, stop) and one exterior numeric programmable touch station, both surface mounted shall be provided and installed.

The door will lock with interior bottom bar slide boltlock for manually operated doors. Chain keeper locks for chain hoist operation.

The door will be face-of-wall mounting.

Electric door operators shall be Overhead Door Corporation, flat profile type F-265I, or equal.

080500 FAUX WINDOWS

Contractor shall fabricate custom faux windows on site using decorative vinyl trim to match decorative door trim. Contractor to provide smoke grey glazing. Paint wall black behind faux window. All holes must be caulked so that no moisture or insects may get behind the faux window – caulk color shall match trim.

080600 THRESHOLDS

Thresholds shall be installed where indicated on the Plans and specified. Thresholds shall be fastened to the concrete by means of screws and fastened into holes in the concrete by means of fiber or plastic plugs. Holes shall be drilled in the thresholds for cane bolts, flush bolts, panic bolts, and similar items with metal sockets for the bolts set in the concrete floor below the thresholds.

Thresholds shall not be installed until construction of the Work is practically complete, unless satisfactory precautions can be taken against heavy traffic during construction.

080700 HARDWARE

080710 GENERAL

The Contractor shall provide all labor, equipment, and materials required to furnish and install complete finish hardware and specialties as indicated and specified.

080720 INSTALLATION

Installation shall be coordinated with other work requiring builder's hardware or attaching to it. The Contractor shall submit necessary copies of schedules, templates, etc. in ample time to avoid fabrication and construction delays. Each item of hardware shall be identified according to approved list and schedule, and shall be made according to template. Hardware shall be delivered in unopened packages bearing manufacturer's labels.

Items of hardware required for completion of work, but not specifically mentioned herein, shall be provided by the Contractor, and shall be suitable for the required service and comparable to those specified. The Contractor shall provide any auxiliary or interconnecting devices necessary to the proper function of items specified.

Necessary screws, bolts, or other fastenings of suitable size and type to secure hardware in position shall be provided by the Contractor and shall match hardware in material and finish. Phillips head type shall be used for all exposed screws. The Contractor shall provide expansion bolts, sex bolts, toggle bolts, or other approved anchorages as applicable to each setting condition. Finish of hardware shall be US 32, polished stainless steel, unless otherwise indicated. Fasteners shall be Type 304 or Type 316 stainless steel, 32D finish.

080730 CATALOG NUMBERS

The Contractor shall require the hardware manufacturer to furnish the proper fastenings whether listed within the hardware sets or not. Finish of fastenings shall equal the finish of hardware sets.

The catalog numbers referred to herein are taken from manufacturers listed. They are used only to establish the quality and type of hardware to be used. Hardware equal in quality and utility, will be accepted provided it conforms in operations, weight, size, workmanship, and finish to the products hereinafter described.

080740 SUBMITTALS

A complete hardware list and schedule shall be submitted as specified elsewhere. Groups listed shall be identified with identical numbers used on the drawings. The Contractor shall require the hardware supplier to furnish the proper templates to the door and frame manufacturer along with a complete hardware schedule for preparation of hardware as furnished in the hardware schedule.

080750 GUARANTEE

All hardware shall be guaranteed for two years from date of acceptance of the work against defects in materials and workmanship in accordance with the General Conditions.

080700 HARDWARE

080760 FINISH HARDWARE

Hardware to be furnished shall be the products of the following named manufacturers, or equal.

- A. THRESHOLD: Unless otherwise indicated thresholds shall be extruded aluminum, 3-3/4-inch by 7/8-inch, with a 215-R1 finish. Thresholds shall be Brookline 2053, Pemko 203A, or equal.

- B. HINGES: Unless otherwise noted hinges shall be 4-1/2-inch by 4-1/2-inch stainless steel (US32D) with a stainless steel pin and bushing. Hinges shall be McKinney T4B3386, Stanley FBB199, or equal, and shall be sized to allow door to clear trim and swing 180 degrees. Two pair per door shall be provided.
- C. DOOR CLOSERS: Door closers shall be LCN 4114H, Norton P-7706H, or equal. Door closers shall have a 215-R1 anodized aluminum cover.
- D. FLOOR STOPS: Floor stops shall be Glynn-Johnson FB 13, FB 14, or FB 18, Sargent and Greenleaf SG 3494, SG 3818, or SG 3819, or equal. Door stops with latch shall be Corbin 359, Sargent 3377 with hooks, or equal.
- F. SILENCERS: Silencers shall be Glynn-Johnson GJ-64-gray; Ives No. 20; or equal meeting Federal Specifications FF-H-111A, Type 1337A. Not less than three silencers shall be provided per leaf.
- G. FLUSH BOLTS: Flush bolts shall be installed at top and bottom of inactive leaf of double doors not equipped with existing devices. Mortise in flush bolt on metal doors, surface mount on wood doors, all with US 26D finish. Mortise flush bolts shall be Ives 258 and surface bolts shall be 253 B26D.
- I. PUSH PLATE: Push plates shall be 16 inches by 4 inches and not less than 0.050-inch thick stainless steel. Finish shall be US 32.
- J. WEATHERSTRIPPING: Weatherstripping shall be as manufactured by Pemko, 305AR, and 350A, and furnished with sheet metal screws, equivalent Zero Weatherstripping Company, or equal. Machine screws will be furnished when strip is to be applied to channel iron frames.
- K. LATCH SETS: All door locks shall be keyed as follows. The keys shall match an Owner-supplied key. This will assure that the key used for the pump station will match other existing Owner's buildings.

<u>Key</u>	<u>Name</u>	<u>Function</u>
1	Master Key	Opens all doors
2	Maintenance	Opens doors D-1, D-2

The hardware supplier shall prepare and submit a lock schedule which complies with the above directions. Four grand master keys shall be furnished.

All keys shall be stamped for ready identification and a list shall be provided giving the key code and numbers of the doors which may be opened by each key.

All keys shall be die marked, marked: "Do not duplicate."

Type I latch sets shall be latch conforming to Federal Specifications FF-H-106-161R. Latch sets shall be Sargent 9 Line with dead bolt above, Schlage "C" and "B" Series, or equal with handicap level handles and 26D finish.

Type II latch sets shall be latch conforming to Federal Specifications FF-H-106-86C mortise lock with handicap lever handles and 26D finish. Latch sets shall be Sargent Series 7700, Schlage "C" and "B" Series, or equal. Exterior building locks shall have security covers similar to Schlage 47-014.

080761 WORKMANSHIP

Each item shall be fitted, adjusted, and secured neatly and firmly in place in perfect working order. Any work not satisfactory to the Engineer shall be properly corrected.

The Contractor shall do all fitting, dismantling, and re-hanging of finish hardware required for finish painting work. Strippable coating, removable tape, or other means shall be used to protect and prevent staining of hardware during construction. Protective measures shall be removed prior to final cleaning for Owner's acceptance of project.

Latch and bolts shall be installed to automatically engage in keepers, whether activated by closers or by manual push. In no case shall additional manual pressure be required to engage latch or bolt in keepers.

Closers shall be carefully adjusted to operate noiselessly and evenly. Closer installation shall be inspected and accepted by closer manufacturer.

080790 DOOR HARDWARE SCHEDULE

See Plans for schedule.

*** END OF DIVISION 8 ***

DIVISION 9

FINISHES

090000 GENERAL

The Contractor shall furnish all labor, materials, and equipment necessary to do all the work specified or required by these Specifications or the Plans. All materials specified by name, brand, or manufacturer, or selected for use under these Specifications, shall be delivered unopened at the jobsite in their original containers bearing the manufacturer's label. No material other than that specified or approved shall be delivered, stored, or kept at the jobsite.

090100 PAINTING - GENERAL

- A. No lead paints shall be used.
- B. All paint for concrete and metal surfaces shall be especially adapted for use around wastewater treatment plants and shall be applied in conformance with the manufacturer's published specifications.
- C. All paint for final coats shall be fume resistant, compounded with pigments suitable for exposure to sewage gases, especially to hydrogen sulfide and to carbon dioxide. Pigments shall be materials which do not tend to darken, discolor, or fade due to the action of sewage gases. If a paint manufacturer proposes use of paint which is not designated "fume resistant" in its literature, it shall furnish full information concerning the pigments used in this paint.
- D. Coatings used in conjunction with potable water supply systems shall have FDA approval for use with potable water and shall not impart a taste or odor to the water.
- E. Complete data on each type and kind of paint and primer shall be submitted to the Engineer for review. Review shall be received from the Engineer before the paint is delivered to the jobsite. This procedure shall be followed whether or not the paint that the contractor proposes to use is named in the Specifications. Review data shall show where and for what uses each paint product is proposed to be used with cross reference made to paragraphs of the Specifications or Painting Schedule. Data submitted on each proposed type and kind of paint shall include data to show that the paint meets the requirements of these Specifications.
- F. Paints not listed in the Specifications and which are submitted for review shall be submitted with a certified ingredients analysis. Data shall include sufficient information for making a complete comparison between specified and proposed paint.
- G. Colors shall be as specified or as selected by the Engineer. Colors will not necessarily be standard colors with all suppliers, and colors shall be mixed by the manufacturer to secure desired color when not standard. The Contractor shall prepare and submit color chip samples for all items which require color selection by the Engineer. If requested for special architectural finishes, the Contractor shall also submit 6-inch by 6-inch samples similar to the intended coated surfaces and coated with the selected color. No color selection will be made until all samples of all paints have been submitted. After all samples of all paints have been submitted, the Engineer will prepare a color scheme using the submitted colors.

- H. All paint shall comply with all requirements of the Air Pollution Regulatory Acts concerning the application and formulation of paints and coatings for an area in which the paints are applied. Specifically, paints shall be reformulated as required to meet the local, State, and Federal requirements.
- I. At the end of the project, the Contractor shall turn over to the Engineer a gallon can of each type and color of paint, primer, thinner, or other coating used in the field painting. If the manufacturer packages the material concerned in gallon cans, then it shall be delivered in unopened labeled cans as it comes from the factory. If the manufacturer does not package the material in gallon cans, and in the case of special colors, the materials shall be delivered in new gallon containers, properly closed with typed labels indicating brand, type, color, etc. The manufacturer's literature describing the materials and giving directions for their use shall be furnished in three bound copies. A typewritten inventory list shall be furnished at the time of delivery.

090101 MANUFACTURERS' INSTRUCTIONS

The manufacturers' published instructions for use as a guide in specifying and applying the manufacturers' proposed paint shall be submitted to the Engineer. Paint shall not be delivered to the job before review of the manufacturer's instructions is given by the Engineer.

A manufacturer's paint will not be considered for review unless that manufacturer's published instructions meet the following requirements:

- A. The instructions must have been written and published by the manufacturer for the purpose and with the intent of giving complete instruction for the use and application of the proposed paint in the locality and for the conditions for which the paint is specified or shown to be applied under this Contract.
- B. All limitations, precautions, and requirements that may adversely affect the paint; that may cause unsatisfactory results after the painting application; or that may cause the paint not to serve the purpose for which it was intended, that is, to protect the covered material from corrosion, shall be clearly and completely stated in the instructions. These limitations and requirements shall, if they exist, include, but not be limited to the following list:
 - 1. Methods of application.
 - 2. Number of coats.
 - 3. Thickness of each coat.
 - 4. Total thickness.
 - 5. Drying time of each coat, including primer.
 - 6. Primer required to be used.
 - 7. Primers not permitted.
 - 8. Use of a primer.

9. Thinner and use of thinner.
10. Temperature limitations during application and after application.
11. Time allowed between coats.
12. Protection from sun.
13. Physical properties of paint including solids content and ingredient analysis.
14. Surface preparation.

Concrete surfaces specified by the paint manufacturer to be acid etched shall be etched in accordance with the manufacturer's instructions. The surface shall then be thoroughly scrubbed with clean water, rinsed, and allowed to dry. The surface shall be tested with a moisture meter to determine when dry before coating.

090102 SPECIFIED PRODUCTS LIST

<u>Brand Name</u>	<u>Manufacturer</u>
Amchem	Amchem Products Fremont, California
Amercoat	Ameron Corporation Brea, California
Borden	Borden Chemical Company 50 West Broad Street Columbus, Ohio 43215
Carboline	Carboline Company St. Louis, Missouri 63144
Glidden	Glidden Coatings and Resins Division of SCM Corporation Cleveland, Ohio 44115
Inertol and Ramuc	Koppers Company, Inc. Koppers Building Pittsburgh, Pennsylvania 15219
Koppers	Koppers Company, Inc. Koppers Building Pittsburgh, Pennsylvania 15219
Mobil	Mobil Chemical Company Maintenance and Marine Coatings Dept. Los Angeles, California 90054

NO-OX-ID	Dearborn Chemical Company 807 Mateo Street Los Angeles, California 90021
Porter	Porter Coatings Division of Porter Paint Company Louisville, Kentucky 40201
Sherwin-Williams	The Sherwin-Williams Company 101 Prospect Avenue, N.W. Cleveland, Ohio 44115
Tnemec	Tnemec Company, Inc. 123 West 23rd Avenue North Kansas City, Missouri 64116

090103 PREPARATION OF SURFACES

Paint surface preparation shall be as specified in the following or as recommended by the paint manufacturer's published application instructions, whichever imposes the most stringent requirements.

All surfaces to be painted shall be clean and dry except that in some cases the paint manufacturer's directions may require wetting the surface before painting.

Except as otherwise provided, all preparation of metal surfaces shall be in accordance with Specifications SP-1 through SP-10 of the Steel Structures Painting Council (SSPC). Where Steel Structures Painting Council Specifications are referred to in this specification, the corresponding Pictorial Surface Preparation Standard shall be used to define the minimum final surface conditions to be supplied. Grease and oil shall be removed by wiping with mineral spirits or naphtha per Specification SP-1. Rust, scale, welding slag, and spatter shall be removed and the surface prepared by hand tool cleaning, power tool cleaning or blast cleaning in accordance with the appropriate Specifications SP-2 through SP-10.

Unless otherwise specified, all iron or steel surfaces which are to be painted as submerged or high temperature metal shall be sandblasted on the site in accordance with Specification SP-10, near white blast cleaning or better. Sandblasting shall provide a roughened surface profile of not less than 2.0 mils in depth. Sandblasting shall be with abrasive Ottawa flint silica 30 to 50 mesh, Clemtex No. 2 silica 20 to 40 mesh, silica sand 20 to 40 mesh or steel grit mixed with shot. All metal surfaces which are to be painted as unsubmerged metal shall be commercial blast cleaned per Specification SP-6 except as otherwise specified, in locations where sandblasting would damage previously coated surfaces and installed equipment, and in locations where dry sandblasting is prohibited. The above locations in which SP-6 commercial sandblasting is not possible shall be given a SP-3 power tool cleaning. This sandblasting shall be done not more than 12 hours ahead of the painting, subject to humidity and weather conditions between the time of sandblasting and painting operations. If any rusting or discoloration of sandblasted surfaces occurs before painting, such rusting or discoloration shall be removed by additional sandblasting. Sandblasted surfaces shall not be left overnight before painting. No surface which is to be sandblasted shall be given a coat of primer or paint in the shop or in the field before sandblasting.

Surfaces to be painted at erection welds, surfaces exposed by damage to the coating, as during erections, shall be cleaned as above before painting.

Threaded portions of valve and gate stems, machined surfaces which are intended for sliding contact, surfaces which are to be assembled against gaskets, surfaces or shafting on which sprockets are to fit, or which are intended to fit into bearings, machined surfaces of bronze trim on slide gates and similar surfaces shall be masked off to protect them from the sandblasting of adjacent surfaces. Cadmium-plated items shall not be sandblasted except that cadmium-plated, zinc-plated, or sherardized fasteners used in assembly of equipment to be sandblasted shall be sandblasted in the same manner as the unprotected metal. Galvanized items shall not be sandblasted except when painting of such items is indicated on the Plans or specified. All installed equipment, mechanical drives, and adjacent painted equipment shall be protected from sandblasting. Protection shall prevent any sand or dust from entering the mechanical drive units or equipment where damage could be caused.

There will be some surfaces which cannot be sandblasted, or which cannot be sandblasted and painted, after the items of which they are a part have been assembled in final position. These surfaces shall be sandblasted, or sandblasted and painted, before the items are put into final position. In some cases while the painting could be done after the items concerned were in place, the limitation on time between sandblasting and painting may make it necessary to paint the surfaces before installation of the items concerned.

Sand from sandblasting shall be thoroughly removed, using a vacuum cleaner if necessary. No surface which has been sandblasted shall be painted until inspected by the Engineer.

All concrete to be painted or coated shall be prepared as specified in DIVISION 3, CONCRETE.

Concrete and masonry surfaces shall be free of dust, mortar droppings and spatter, fins, loose concrete particles, form release materials, oil, grease, and other deleterious materials. If required by the coating manufacturer, such surfaces shall be etched as specified above or brush-off blast cleaned.

Wood surfaces to be painted shall be cleaned of dirt, oil, or other foreign substances with mineral spirits, scrapers, sandpaper or wire brushes. Sandpaper any roughness after first prime coat. Wood shall be cleaned and dusted before painting. Shelves, drawers, benches, and associated woodwork shall be sanded before painting and lightly sanded between coats. All knots and sappy places shall be coated with liquid shellac of not over two pound cut after the priming coat has been applied and dried. Nail holes, cracks, open joints and other defects in all interior woodwork shall be filled with putty colored to match the finish coats after the priming coat has been applied and is dry.

All painted surfaces shall be dusted between coats and high gloss finishes shall be lightly sanded and dusted between coats unless otherwise directed by the manufacturer.

Surfaces which are to be painted with other than bituminous paint and which have had a bituminous coating (such as coal-tar varnished pipe), shall be sealed with not less than two coats of Inertol Tar Stop, Sherwin-Williams Metalatex B-42 W100, Glidden Insulcap, or equal, in sufficient quantity to permanently prevent bleeding of the bituminous coating.

Galvanized surfaces which are to be painted shall first be treated with Koppers No. 40 Metal Conditioner, Amercoat No. 59, Galvaprep No. 5 as manufactured by Amchem Products, or equal. Pretreatment for galvanized metal shall be applied not more than 48 hours prior to coating.

All fiberglass to be painted shall be lightly sandblasted or sanded to roughen surfaces just prior to painting.

Plastic surfaces shall be solvent-washed to dull the surface, using a vinyl thinner approved by the finish coating manufacturer.

Aluminum, copper, and other metal surfaces shall be lightly sanded or receive surface preparation as specified in the following or as recommended by the paint manufacturer.

090104 APPLICATION OF PAINT

The applicator of the paint shall have had past experience in applying the type or types of coatings and under similar conditions that he will be required to meet in this Contract. The Contractor shall verify the paint applicator's qualifications and past performance before subcontracting the work to him.

No painting shall be done under dusty conditions, during or immediately after a rain, during rainy weather, when the ambient and/or surface temperature is less than 50 degrees, or when the temperature exceeds that recommended for application by the paint manufacturer. Relative humidity shall be between 30 and 85 percent and the dew point shall not be within 5 degrees of the surface temperature.

Paint may be applied by brush, roller, trowel, or spray, unless the manufacturer's recommendations or these Specifications call for some particular type of application. Where spray application is used, each coat of paint shall be applied to a thickness equivalent to a brush coat application at a coverage not greater than that specified by the manufacturer for a brush coat application. All spray painting shall be by the airless method except where specifically allowed by the Engineer for architectural painting. All air spray units shall have operable line filters for removal of all oil and moisture. The Contractor shall demonstrate the efficiency of the line filters before applying any paint.

Spray painting shall be conducted under controlled conditions and the Contractor shall be fully responsible for any damage to adjacent work or adjoining property occurring from spray painting.

All work shall be done leaving the finished surfaces free from drops, ridges, waves, holidays, laps, or brush marks. Drop cloths and other coverings shall be so placed at all times as to protect floors, other surfaces, and equipment from spatter and droppings. Hardware, plates, lighting fixtures, nameplates, and similar articles which are not to be painted shall be masked off or removed completely. After completion of painting, any spatter or droppings shall be removed.

Primer and intermediate coats of paint shall be unscarred and completely integral at the time of application of each succeeding coat. Each coat shall be subject to the inspection and approval of the Engineer before the next succeeding coat is applied, and defective work of any kind shall be deemed sufficient cause for stripping, removal, and reparing if required by the Engineer followed by recoating the entire surface involved.

Except as otherwise provided in these Specifications, or approved in writing by the Engineer, prime coats, undercoats, and finish coats on any one item shall be of the same manufacturer. If the incorrect prime coat is applied for any reason, it shall be sandblasted off and replaced with the specified primer.

When multiple coats of the same material are specified, the prime coat and undercoats applied shall be tinted with aluminum powder, lamp black, or other suitable pigment to distinguish it from the following coat and finish coat.

Sufficient time shall be allowed between coats to insure proper drying unless these Specifications or manufacturer's recommendations specifically state otherwise. Excessive time or exposure between coats shall not occur in cases where such excessive time or exposure will impair the bond between coats. To prevent impairment of bond between coats, space heaters shall be provided to dry the coat or keep the coating dry, if recommended by the paint manufacturer or required by the Engineer.

The number of coats specified is the minimum to be applied. Suction spots between coats shall be touched up, and additional coats shall be provided if required to produce a finished surface of solid, even color, free from defects. The total thickness of the coating shall be as specified. Additional coats of paint shall be added if necessary to bring the total thickness up to not less than that specified. No holidays shall be left. Particular care shall be used to assure that the specified coverage is secured on the edges and corners of all surfaces. Additional brush coats shall be applied if necessary to cover the edges and corners. The Contractor shall control and check the dry film thickness of all coatings. The Contractor shall control and check the dry film thickness on metal surfaces with a correctly calibrated thickness meter and shall check for holidays with a low-voltage holiday detector. The Engineer may use the Contractor's detector for additional checking. However, the Engineer will use an Elcometer to check the dry film thickness of the coatings, and his findings utilizing this meter will be final as to the dry film thickness of the applied coatings.

Damaged paint or scratched painted surfaces shall be sanded smooth before repainting. Sanding and repainting shall be done to such a degree and in such a manner that all evidence of the scratches or damages are obscured.

090110 FACTORY-PAINTED EQUIPMENT

Except as otherwise noted on the Painting Schedule or specified, the following items shall receive final finish coats at the factory and shall be protected against damage during transit, storage, and erection. Damaged areas must be refinished as the original. Factory-painted items shall be of a color specified, selected, or approved by the Engineer.

- Air conditioning and heating units
- Electric Distribution Centers
- Gauges and meters
- Instrument and control panels
- Instruments
- Light fixture not specified to be field painted
- Meter panels
- Transformers
- Transmitters
- Ventilating fans

090120 ITEMS NOT PAINTED

The following items shall not be painted, unless specifically called for:

- Aluminum grating
- Aluminum, brass, bronze, copper, plastic, rubber stainless steel, chrome, everdur, or lead
- Buried or encased piping or conduit
- Exterior concrete
- Galvanized pipe trays and cable trays (supports or hangers for these shall be painted)

- Galvanized steel framing
- Grease fittings
- Galvanized or aluminum ducting
- Nameplates
- Serial numbers
- Steel encased in concrete or masonry
- Warning or operating instruction labels

090130 PAINTING CONCRETE, MASONRY, PLASTER, AND STUCCO

Except as otherwise noted on the Painting Schedule or specified herein, exterior concrete shall not be painted. Interior floors shall be sealed and painted as noted, and other interior surfaces including ceilings, shall be painted as set forth in the Painting Schedule. Unless otherwise indicated, porous block shall be filled to provide a smooth base. Form release agents shall be removed from poured or precast surfaces by sandblasting or as recommended by the paint manufacturer. Concrete masonry, plaster, and stucco shall be coated as specified in the following. Exterior masonry panels shall be sealed and painted as indicated on the Painting Schedule. See DIVISION 4 for masonry sealer.

090133 INTERIOR ABOVE AND BELOW GRADE CONCRETE

090133.02 INTERIOR SEMIGLOSS FINISH - LATEX ENAMEL

Masonry, concrete, stucco, and plaster surfaces exposed to view inside the building and structures indicated in the Painting Schedule or specified to have a semigloss finish shall be painted with two or more coats of semigloss latex enamel over one coat of primer. Total dry film thickness shall be not less than 4.4 mils.

Finish coats shall contain not less than 29 percent solids by volume and 25 percent pigment by weight. Paint systems shall be as follows or equal.

SHERWIN-WILLIAMS: Primer coat shall be Sherwin-Williams Bloc-Tex where paint is applied over porous surfaces or masonry block. Primer in other locations shall be one or more coats of Metalatex B-42 W100 applied to a dry film thickness of not less than 2.0 mils. Finish coats shall be two or more coats of Hi-Hide Latex Semi-Gloss Enamel Series B40 applied to a dry film thickness of not less than 24 mils.

090135 SUBMERGED CONCRETE AND MASONRY

In general, items shall be treated as submerged if they are to be at any time underwater, are in structures which normally contain water or are below the tops of walls of water containing structures. Except as otherwise noted in the Painting Schedule, or indicated on the Plans, submerged concrete and masonry shall not be coated.

090134.03 CHEMICAL RESISTANT COATING

Interior floors and walls of all sumps, spill containment structures and other areas shall be coated with a heavy-duty material designed for high chemical service.

Concrete shall be prepared using a brush blast sand blast over the concrete to be coated. All pits or holes shall be filled with grout to a F5 Finish. The primer shall be one coat of a polyamine epoxy. The containment areas floor and walls shall be painted with the following system or equal.

TNEMEC: Primer: One coat of Series 201 Epoxoprime - Polyamine Epoxy Top Coat: one coat of Series 282 Tneme-Glaze - Polyamine Novolac Epoxy

090140 PAINTING METAL SURFACES

Except as otherwise specified or indicated on the Painting Schedule, all metal shall be painted. Metal surfaces shall be primed and painted as specified in the following paragraphs.

Steel and miscellaneous iron items which are to be built into masonry or concrete shall, unless otherwise noted, have no field painting. Steel and miscellaneous iron items which have had a shop primer and which will be concealed above the ceilings shall be field primed. This includes but is not limited to the unexposed underside of steel roof decks and structural steel items such as beams, channels, and angles. Touching up of these items shall be done after erection but before installation of the ceiling system. No further painting of these items will be required.

090141 PRIMING OF METALS

Metals shall be primed as specified in the following.

090141.01 SHOP PRIMING OF METALS

Certain items have been listed to receive complete finish at the factory. Surfaces specified to be field sandblasted and galvanized surfaces, shall not be shop coated. All other ferrous surfaces, except stainless steel and surfaces specified or shown to receive epoxy or grease type coatings, shall receive a shop coat of primer compatible with the finish coats specified. Primers shall be as specified for field priming. Surface preparation shall be as specified hereinbefore. Shop primer shall be compatible with field primer and finish coats. Shop primer shall be applied to a dry film thickness of not less than 2.0 mils.

090141.02 FIELD PRIMING OF METALS

All shop primed metal surfaces shall be field primed as follows before the finish coats are applied. All abraded, scratched, or otherwise damaged areas in the shop prime coat shall be sanded smooth or receive power tool cleaning SP-3 and then spot primed. The entire surface shall then be given a second prime coat compatible with the shop prime coat and the finish coats. Where the entire shop priming is failing, weathered excessively, or where recommended by the paint manufacturer's representative, the entire shop prime coat shall be removed with SP-6 commercial sandblast surface preparation before repriming.

Unless specified under the individual painting system, metal shall be field primed as specified in the following. In general the specified primers are not universal type primers and are not compatible with epoxy, chlorinated rubber, and vinyl finish coats. Primers for epoxies, chlorinated rubber, and vinyl coating primers have been specified under the individual coating system.

Paint manufacturer's representative shall recommend changes in metal primers where specified primers and finish coats are not compatible. Changes shall be submitted for approval. Where the shop primer is not compatible with field primer and/or finish coats, the shop primer shall be removed by sandblasting to

not less than SP-6 commercial sandblast. All shop primer shall be removed from all metal to be installed as submerged metal by sandblasting to near white SP-10.

Primer for ferrous metal shall be a long oil alkyd primer unless a phenolic-alkyd primer is recommended by the paint manufacturer. Phenolic-alkyd primers shall be used as field primers only and shall be applied not less than one week before application of the finish coats. Phenolic-alkyd primers shall be Koppers Pug, Tnemec 77, or equal. Primers shall be Sherwin-Williams Kromik Metal Primer E41-N1, Glidden Glid-Guard Primer No. 4570, Mobil Primer 13-R-53, Tnemec 99 Red Metal Primer, or equal. Primer shall be applied to a dry film thickness of not less than 2.0 mils. Primer shall be finish coated within the time recommended in writing by the paint manufacturer. Primed surfaces exposed longer than this recommended period shall be SP-7 sandblasted and reprimed prior to finish painting.

Galvanized, sherardized, aluminum, copper, or bronze surfaces to be painted shall be solvent cleaned and receive a surface preparation as specified hereinbefore, then either wash coated and primed or primed with a special primer in accordance with the directions of the manufacturer of the finish coats. Unless specifically specified otherwise by the paint manufacturer, the primer for aluminum shall be a zinc chromate type primer, Sherwin-Williams B50-Y1, Glidden 471, or equal.

090142 PAINTING ARCHITECTURAL METAL

Doors, ventilators, louvers, grilles, exposed sheet metal, exposed flashing, and other architectural metals, structural or nonstructural, that is an integral part of the structure or building shall be painted as specified or as indicated on the Painting Schedule. All metal shall be primed as specified. The painting systems for interior and exterior architectural metals shall be as follows.

090142.02 SEMI-GLOSS FINISH

Semi-gloss finish for interior and exterior architectural metal shall consist of two or more exterior acrylic latex finish coats over one or more coats of primer to a dry film thickness of not less than 5.0 mils. Acrylic latex finish coats shall contain not less than 32 percent solids by volume and not less than 23 percent pigment by weight. Finishing systems shall be the following or equal.

GLIDDEN: Finish coats shall be Glidden Spred Latex Enamel 3900 applied to a dry film thickness of not less than 3.0 mils.

MOBIL: Finish coats shall be Mobil Series 44 Water Acrylic Enamel.

SHERWIN-WILLIAMS: Finish coats shall be two or more coats of Sherwin-Williams Series B-42 Metalatex Semi-gloss Enamel to a dry film thickness of not less than 3 mils.

090142.03 GLOSS FINISH

Gloss finish for interior and exterior architectural metal shall consist of two or more coats of alkyd enamel applied over one or more coats of primer to a dry film thickness of not less than 5.0 mils. Finish coats shall be not less than 35 percent solids by volume and 29 percent pigment by weight. Coating systems shall be as follows or equal.

GLIDDEN: Finish coats shall be two or more coats of Glid-Guard Alkyd Industrial Enamel No. 14204 to a dry film thickness of not less than 3.0 mils.

MOBIL: Finish coat shall be two or more coats of Mobil Series 42 Gloss Water Acrylic Enamel.

PORTER: Finish coats shall be two or more coats of Porter I.A.-24 applied to a dry film thickness of not less than 3.0 mils.

SHERWIN-WILLIAMS: Finish coats shall be two or more coats of Ken Lustral Enamel Series F65 applied to a dry film thickness of not less than 3.0 mils.

TNEMEC: Finish coats shall be two or more coats of Tnemec-gloss Series 2 to a dry film thickness of not less than 3.0 mils.

090143.03 EPOXY COATINGS

Epoxy coatings for submerged metal shall be applied where specified or noted on the Painting Schedule. Epoxy shall be a colored polyamide cured epoxy consisting of not less than 49 percent solids by volume. Coatings and pigments used on potable water service shall have FDA approval and shall be approved for use with potable water. Painting systems shall be as follows or equal applied to dry film thickness of not less than 10 mils. The finish coat color shall be white. The system shall be a two or three coat system consisting of a prime coat and two topcoats. The paint systems shall be as indicated in this section. All surfaces receiving this paint system shall have a near white blast surface preparation of SSPC - SP10.

This product shall meet or exceed the following test requirements established:

Abrasion:	Method: ASTM D 4060, CS-17 Wheel, 1,000 grams load. Requirement: No more than 120 mg. loss after 1,000 cycles.
Adhesion:	Method: ASTM D 4541 Requirement: Not less than 950 psi pull, average of three tests. Method: ASTM D 3359 Method B, Crosshatch adhesion. Requirement: Not less than a rating of 5, (no removal), average of three tests.
Fresh Water:	Method: Coating system applied to SSPC-SP10 cleaned hot-rolled steel, cured 7 days prior to testing and immersed in aerated tap water at 77 F. Requirement: No blistering, delamination or other loss of film integrity after 4 years exposure.
Salt Spray: (FOG)	Method: ASTM B 1176 applied to SSPC-SP10 cleaned hot rolled steel. Requirement: No blistering, cracking or delamination of film. No more than 1/16 in. rust creepage at scribe, and no more than two percent rusting at edges after 1,000 hours exposure.
Dielectric Strength	Method: ANSI/ASTM D 149 (short-term test) Requirement: No less than 1,050 volts/mil, average of five tests.
TNEMEC:	Three or more coats of Series 20 - Pota-Pox to attain the required thickness.

090144 MISCELLANEOUS UNSUBMERGED METALS

Interior and exterior miscellaneous unsubmerged metals exposed to view that are not specified to be painted otherwise or left unpainted shall be painted with a long oil alkyd gloss enamel.

These items shall include but not be limited to the following:

- Pipe hangers, supports, and saddles; conduits, cable tray hangers and supports.
- Motors, internal combustion engines, and motor and engine accessory equipment
- Drive gear, speed reducer housings; belt, chain, and coupling housings (inside and out); and gear drive miscellaneous equipment
- Floor-mounted valve and gate operators and stands, and other valve operators and operator supports.
- Structural steel (where not specified under architectural coatings), crane and hoist rails, and exterior of tanks and other containment vessels (not otherwise specified).
- Mechanical equipment supports, drive units, and all accessories.
- Exterior of conveyor and elevator housing including bucket elevators, screw conveyors, pneumatic transfer system, etc.
- Sludge collector mechanisms, thickener mechanisms, and similar drive mechanisms; access bridges, support beams, and similar structures above the top of basin walls
- Ladders, ladder guards, ferrous handrails, light standards, light fixtures, manhole covers, and hatchways.
- Other miscellaneous metals listed or not listed on the Painting Schedule.

The system shall be as specified in 090146.

090145 UNDERGROUND METALS

All exposed underground metals shall be coated. Pipe coatings are covered under the individual pipe sections in DIVISION 15, PIPE AND PIPING SYSTEMS.

Underground valves and valve boxes shall be coated with not less than two coats of asphalt varnish in accordance with AWWA C 500.

Underground pipe flanges (excluding pipe), corrugated metal pipe couplings, flexible pipe couplings and miscellaneous underground metals not specified otherwise to receive a protective coating, shall be coated with not less than 20 mils of T.C. Mastic manufactured by the Tapecoat Company; Bitumastic No. 50 manufactured by the Koppers Company, Inc.; or equal.

090146 PIPE COATINGS

Pipe (insulated and uninsulated), miscellaneous pipe fittings, and valves shall be coated and color coded as specified in the following.

090146.01 PIPE COATING COLOR AND IDENTIFICATION

Exposed pipe shall be color coded as listed in the following table, except submerged pipe, pipe supported in cable or pipe trays (small diameter), and pipe less than 3/8-inch in diameter and where specified otherwise. Pipe nominal 3/8-inch or smaller shall be painted the same as the wall, ceiling, or piece of equipment to which it is attached.

All pipe to be color coded shall be painted the background color indicated in its entirety. When so indicated, it shall be further identified by an 8-inch wide circumferential band at its origin and termination, on each side of all walls, above and below all floors and ceilings, at points of entering or leaving pipe or cable trays, at all valves and fittings, and at no greater than 25-foot intervals between such markings.

Where two or more pipes run parallel, markings shall be applied in the same relative location on each so as to be in vertical or horizontal linearity as the case may be and present a neat appearance. Where numerous fittings occur close together as in manifolds and around equipment, the above specifications as to location of banding shall be modified as indicated by good judgment to prevent a cluttered appearance.

Loose handles, wrenches, operating keys, etc. for valves shall be painted along with the valves.

PIPE COLOR CODE CHART

<u>Pipe Contents</u>	<u>Background Color</u>	<u>Band</u>
Water, Potable	Blue	White

COLOR CHART

<u>Color</u>	<u>Sherwin-Williams</u>	<u>Glidden</u>	<u>Koppers</u>
Blue	Pale Blue F65-L7	Atomic Blue	Light Blue 301
Brown	Rich Brown F65-N11	Warm Brown 4537	Dark Brown 318
Gray	Light Gray F65-A2	Neutral Gray 4572	Medium Gray 307
Light Green	Pale Green F65-G42	Metal Green	Jade Green 336
Medium Green	Medium Green F65-G40	Medium Green 4554	Oliver Green 305
Orange	Orange F65-E36	Orange 4552	Orange 393
Red	Vermillion F65-R1	Red 4556	Vermillion 314
White	Semi-Gloss White F65-W2	White 4550	White 311
Yellow	Medium Yellow F65-Y46	Medium Yellow 4560	Medium Yellow 339

ANSI colors shall be in accordance with ANSI Z 53.1 (latest edition).

090146.02 COATING METAL PIPE

Color coded metal pipe shall be coated with a high gloss alkyd system as indicated on the Paint Schedule and specified below. Colors for color coating of pipe shall be as specified above. Metal pipe shall be power tool cleaned SP-3 or commercial blast cleaned SP-6.

ALKYD SYSTEM: The alkyd system shall consist of two or more finish coats applied over a primer to a total dry film thickness of not less than 6 mils. Paint shall consist of not less than 42 percent solids by volume and 32 percent pigment by weight.

The product system shall meet or exceed the following requirements: (Published literature or test data showing conformance to these tests shall be submitted).

1. Adhesion: Not less than a rating of 4.5, average of 3 trials. (ASTM D 3359 Method B, Crosshatch Adhesion).

2. Exterior Exposure: No less than a gloss reading of 25 as measured with a 60-degree gloss meter after 12 months exposure. (Exposed at 45 degrees facing south, South Florida marine).
3. Flexibility: No less than 30 percent elongation. (Passes 1/8" mandrel) (ASTM D 522)
4. Salt Spray (Fog): No blistering, cracking or delamination of film; no more than 1/16 in. rust creepage at scribe and no more than 2 percent rusting at edges after 500 hours exposure (ASTM B 117)

Finish systems shall be the following or equal.

Tnemec: Apply one coat of Series 37 Alkyd-Phenolic rust-inhibited primer. Apply two or more top coats of Series 2H Hi-Build Alkyd Enamel.

ALUMINUM SYSTEM: The aluminum system shall consist of one coat of metal primer followed by two coats of aluminum paint. Where aluminum paint occurs over insulation, the two coats of aluminum paint shall be applied over the insulation after priming as specified. The aluminum coats shall be applied to a dry film thickness of not less than 2.5 mils.

Finish systems shall be the following or equal.

Aluminum paint shall be not less than 12 percent pigment by weight and volume solids not less than 42 percent. Paint systems shall be the following or equal system.

Glidden: Apply one coat of primer as specified for alkyd system followed by two coats of Glidden 5227 Glid-Guard Alkyd Tank and Structural Enamel.

Mobil: Apply one coat of primer as specified for alkyd system followed by two coats of Mobil 11-A-33 Ready Mix Heavy-Duty Aluminum.

Porter: One coat of Porter 297 primer to steel and black iron and Porter 296 primer to galvanized surfaces after pretreatment followed by two coats of Porter 293.

Sherwin-Williams: Apply one coat of primer as specified for alkyd system followed by two coats of Silver-Brite Heavy-Duty Aluminum Paint B59 S2.

090149 DISSIMILAR METALS

Where aluminum surfaces come in contact with dissimilar metals, except Type 304 or Type 316 stainless steel, aluminum surfaces shall be kept from direct contact with said metal by use of neoprene gaskets or washers, polyethylene self-adhesive tape (two wraps of 20-mil tape), or washers. Galvanizing or paint will not be considered as adequate protection.

Aluminum surfaces to be placed in contact with wood, concrete, or masonry construction shall be given a heavy coat of an alkali-resistant bituminous paint or two coats of a zinc chromate primer before installation. The bituminous paint shall be Koppers Bitumastic Black Solution, Porter Tarmastic No. 104, Tnemec 449 Heavy-Duty Black, or equal. The paint shall be applied as it is received from the manufacturer without the addition of any thinner, and the surface shall be cleaned according to the manufacturer's instructions. Not less than two coats shall be applied. Zinc chromate shall be allowed to

air dry 24 hours before the aluminum is placed in contact with the concrete. Paint shall be Sherwin-Williams zinc chromate primer B50 Y1, Glidden No. 5533 zinc chromate primer, or equal. All exposed surfaces shall be cleaned of any coating before installation.

Coatings shall be continuous and holiday free.

All stainless-steel bolt and screw surfaces in contact with aluminum shall be coated with Never-Seez by Never Seez Compound Corp., WLR No. 111 by Oil Research Inc., or equal.

090150 GRAFFITI PROTECTANT

All exterior CMU faces shall be coated with a graffiti protection system. All surfaces receiving the system shall be cleaned and dried as per SSPC-SP13/NACE 6.

The graffiti protection system shall consist of two coats of Dur A Pell GS Series V626 or equal. System shall be applied as per manufactures recommendations.

090170 PAINTING FIBERGLASS AND PLASTIC

Exposed fiberglass and plastic indicated on the Painting Schedule or specified shall be coated with two coats of vinyl paint following surface preparation to a dry film thickness of not less than 4 mils. PVC and other plastics shall have the surface roughened by solvent washing with xylene or vinyl thinner approved by the paint manufacturer. Fiberglass shall be cleaned per SSPC SP-1 (solvent cleaning) and coated immediately after drying. Painting systems shall be the following or equal systems.

AMERON: Apply two coats of Amercoat No. 99.

GLIDDEN: Apply one coat of Glidden 5521 Vinyl-Cote Primer followed by one coat Glidden 5514 Double Build Vinyl.

MOBIL: Apply two coats of Mobil Series 80.

KOPPERS: Apply one coat of Rigortex 3305 Intermediate Coat followed by one coat of Rigortex 3305 Finish Coat.

TNEMEC: Apply one coat of Vinoline 53 Hi-Build Mastic followed by one coat of Vinoline 35.

090181 FLOOR AND WALKWAY COATINGS

Where indicated on the Painting Schedule or specified, floor and walk surfaces shall be painted with a two-component modified polyamine cured epoxy liquid and a colored quartz broadcast aggregate applied by double broadcast or as a slurry broadcast to provide a minimum 1/8" thickness. Prior to coating, concrete floors shall be cured a minimum of 28 days and thoroughly etched with muriatic acid as recommended by the paint manufacturer. After etching, the muriatic acid shall be thoroughly removed with clean water. The concrete shall be allowed to dry not less than 48 hours following cleaning before application of the coating. The system shall be a minimum of 3 coats per manufacturer's recommended thickness per coat with the final coat being a skid resistant surface and two-component, modified polyamine cured epoxy glaze. A decorative flake shall be broadcast at random. Coatings shall be the following or equal systems:

TNEMEC: Series 222 Deco-Tread FC

TNEMEC: Series 284 Deco-Clear

TNEMEC: Series 224 Deco-Fleck

FEDERAL INTERNATIONAL CHEMICALS: Series PR-14 Quick Primer/Sealer with a top coat of UR-6 aliphatic urethane.

The finish color and flecks shall be chosen by owner and the product system shall meet or exceed the following test requirements.

ABRASION: Method - ASTM D 4060, CS-17 Wheel, 1,000 grams load
Requirement: No more than 105 mg. loss after 1,000 cycles

ADHESION: Method: ASTM D 4541. Coating system applied to sandblasted concrete and
cured 14 days at 77 F.
Requirement: Not less than 375 psi pull, average of three tests.

090182 NONSKID FLOOR OR WALKWAY

Where indicated on the Plans or specified, floor and walkways shall be skid-proofed as follows.

An additional coat of paint shall be applied to the surface. While the surface is still wet, the area to be made nonskid shall have blow onto it clean, sharp, dry silica sand of a size all passing a 20-mesh screen, but all retained on a 40-mesh screen. The surface of the paint and sand shall be allowed to dry for at least 48 hours, after which time the excess sand shall be broomed off and the area given a final coating of the same paint applied to such thickness as to completely cover the sand grains but not to fill the valleys between. The area outside that which is to be skid-proofed shall be protected from sand by masking tape during the operations.

090183 WOOD TIMBER COATINGS

Where indicated on the Painting Schedule or specified in the plans, wood surfaces shall be stained with one coat of stain and varnished. Exterior exposed timbers shall be coated with two coats of semi-gloss varnish. Interior timbers shall be coated with a single coat of satin varnish. All timber coatings shall be manufactured by Sherwin-Williams. Stain colors shall be determined by the owner.

090184 SPECIAL COLOR AND PAINTING REQUIREMENTS

Items specified in the following shall be finish color coated as specified. ANSI colors shall conform with (OSHA) ANSI Z53.1-1971 and latest revisions.

Color coating shall be with the system specified for the equipment, concrete, etc. Where the coating system is not specified and color coating is required, the items shall be coated with a primer and two or more coats of Kem Lustral Enamel Series F65; a primer and two coats Glid-Guard Alkyd Industrial Enamel; or equal.

090184.01 RED

Items listed in ANSI Z53.1-1971, Section 2.1 shall be painted ANSI Red. In general, these items shall include fire protection equipment and apparatus; danger signs and locations; and stop bars, buttons, or switches. In addition all hose valves and riser pipes, fire protection piping and sprinkler systems, and electrical stop switches shall be painted ANSI Red.

090184.02 ORANGE

Items listed in ANSI Z53.1-1971, Section 2.2 shall be painted ANSI Orange. ANSI Orange shall be used as a basic color for designating dangerous parts of machines or energized equipment which may cut, crush, shock, or otherwise injure and to emphasize such hazards when enclosure doors are open or when gear belt or other guards around moving equipment are open or removed, exposing unguarded hazards. In

addition moving machinery having a linear or peripheral speed in excess of 10 feet per minute, which is either inadequately guarded due to physical problems or may be operated with the guard removed, rims of sprockets, gears, pulleys, etc.; crossheads of large engines and compressors; and fly-wheels shall be coated ANSI Orange.

090184.03 YELLOW

Items listed in ANSI Z53.1-1971, Section 2.3 shall be painted ANSI Yellow. Yellow shall be the basic color for designating caution and for marking physical hazards such as striking against, stumbling, falling, tripping, and "caught in between." In addition an 8-inch wide strip on the top and bottom tread of stairways shall be coated.

090184.04 GREEN

Items listed in ANSI Z53.1-1971, Section 2.4 shall be painted ANSI Green. Green shall be the basic color for designating safety and the location of first-aid equipment. In general, gas masks, first-aid kits, eye wash facilities, and safety deluge showers shall be coated ANSI Green.

090184.05 PURPLE

Items listed in ANSI Z53.1-1971, Section 2.5 shall be painted ANSI Purple. In general, atomic sludge density meters shall be coated ANSI Purple.

090199 PAINTING SCHEDULE

Painting shall be as specified in this section of the Specifications and as indicated on the Plans and specified herein.

In general, all steel, iron, and wood surfaces shall be painted unless specifically indicated or specified otherwise. Concrete surfaces shall be painted only where indicated or specified. In general, exterior concrete and concrete exposed to wastewater inside basins and tanks shall not be painted and concrete and masonry inside buildings, basements, equipment rooms, etc. shall be painted. Aluminum surfaces shall not be painted unless specifically indicated or specified.

The Painting Schedule sets forth a listing of the type of items and type of paint system which they shall receive. This Schedule shall compliment the lists of items to be painted listed hereinbefore. This listing is not necessarily complete, and items of a like nature as shown on the Painting Schedule shall be painted the same as if they were included in the Painting Schedule. In case of question as to whether an item is to be painted, or as to type of paint system to use, the Engineer shall be consulted to render a judgment.

- A. Schedule of masonry and concrete surfaces to receive paint.
 - 1. Floor Enamel, Floors and Walkways (090181, 090182)
 - a. Interior floor slab
 - 2. Masonry Sealer (040130 and 090130)
 - a. Masonry building exterior walls

- b. Masonry retaining walls (not coated with anti-graffiti coating)
 - 3. Sidewalks and curb and gutter
 - a. Sealant as per DIVISION 3.
- B. Schedule of wood surfaces to receive paint.
 - 1. Varnish, Semi-Gloss – 2 coats (090183)
 - a. Stain per section 090183_____
 - b. Exterior wood timber members and trim
- C. Graffiti Resistant Paint
 - 1. North face of north retaining wall, concrete and masonry
 - 2. West face of west concrete fence
- D. Schedule of metal surfaces to receive paint.
 - 1. Acrylic latex semi-gloss (090142 and 090142.02).
 - a. Miscellaneous architectural metals and flashing not color anodized.
 - b. All exposed structural steel.
 - 2. Epoxy (090143.03)
 - a. Exposed steel in contact with water.
 - b. Interior of fabricated steel pipe and fittings.
 - c. Exterior of steel pipe and sleeves cast in concrete.
 - d. Interior and exterior of pump cans and fabricated pump base
 - 3. Coal tar mastic (090145).
 - a. Underground flexible couplings.
 - b. Buried valves and valve boxes.
 - 4. Alkyd gloss enamel (090146 and 090146.2).
 - a. Piping, supports, and piping insulation (all PVC pipe exposed shall be coated as specified under 090170).
 - b. Valves, valve operators, stands, and all piping appurtenances.

- c. Pumps, piping, and pipe fittings
 - d. Equipment supports
- E. Colors.
 - 1. See 090100, 090146, 090146.01, and 090184.
- F. Pipe Marking.
 - 1. See 090146.01.
- G. Dissimilar Metals
 - 1. See 090149.
- H. Safety Strips
 - 1. See 100140 and 100150.

*** END OF DIVISION 9 ***

DIVISION 10

BUILDING SPECIALTIES

100100 GENERAL - SAFETY EQUIPMENT

This Section of the Specifications includes miscellaneous safety equipment to be installed throughout the treatment plant at various locations. The Contractor shall furnish and install, as called for in these Specifications or as required for proper operation of equipment, all items specified in this Section, including bolts, caulking materials, hangers, supports, and such incidental materials and equipment as are required to make the items complete and ready for use.

The equipment furnished by the Contractor shall meet with the acceptance of the pertinent agency or organization controlling quality and safety of such equipment. Pertinent agencies or organizations shall be recognized nationally or shall be public agencies of the State of Utah and shall include OSHA, Utah-OSHA, UL, NFPA, ASME, and others as applicable.

100130 FIRST AID KIT

The Contractor shall supply one (1) 24-unit first aid kit in each of the following locations:

- (1) Central Zone Booster Pump Station

The kit shall meet OSHA, NFPA, and Federal Specification GG-K-391A requirements. The kit shall be Mine Safety Appliances Company Catalog No. 2478, Van Waters and Rogers No. 56613-048, or equal. The kit shall be wall mountable.

100150 PAINT STRIP

A 4" wide OSHA red strip shall be painted around the perimeter of the raised concrete electrical pad in the pump station.

100200 GENERAL - IDENTIFICATION DEVICES

Submittals shall include manufacturer's catalog data, color samples, template drawings, installation details, and selected color.

All installations shall be vandal-resistant where possible. Graphics shall be of highest quality and shall have smooth, uniform colored finishes.

Manufactured items shall be installed in accordance with the manufacturer's recommendations.

Installation shall be level, plumb, true to plane, and securely attached to structures.

100210 METAL SIGNS

Metal signs shall be furnished and installed as indicated on the Plans and specified herein. Metal signs shall be designed and laid out to meet OSHA requirements such as lettering size and colors, sign size and background colors. Metal signs shall consist of silk-screened letters painted onto an 18-gauge aluminum

sheet (lighter gauge may be used for 5-inch by 3-1/2-inch signs), with rounded corners and holes for fasteners. Metal signs shall be as furnished by Zumar Industries, Inc.; Couch and Philippe, Inc.; Safeway Sign Company; or equal. All fasteners shall be stainless steel.

100220 PLASTIC SIGNS

Plastic room signs shall be 1/4-inch-thick acrylic plastic with white vinyl letters. Projecting signs shall be double with internal frame and concealed attachment. Colors shall be as selected by the Engineer.

Lettering shall be "Helvetica Medium" style.

Manufacturer's recommended adhesive foam, adhesive, and other attachment devices shall be provided as required. Installation shall be without exposed screws.

100230 SIGN SCHEDULES

Plastic and metal signs shall be provided in accordance with the following schedules. Exact locations of all signs shall be subject to acceptance by the Engineer.

100234 METAL SIGN SCHEDULE

<u>Legend</u>	<u>Location</u>
DANGER - This equipment starts automatically by remote control	Pump Motor, Size 10-inches wide by 14-inches high, (3 Required) Central Zone Booster Pump Station
DANGER - HIGH VOLTAGE - Keep Out	Mounted on exterior pump station doors (2 Required) Central Zone Booster Pump Station Size: 24-inches by 24-inches. (See also 160115)

100238 PLASTIC SIGN SCHEDULE

<u>Legend</u>	<u>Location</u>
FIRST AID KIT	Mounted next to First Aid Kit (1 Required) Central Zone Booster Pump Station
EXIT	Mounted above pump station door. Standard Size. (2 Required) Central Zone Booster Pump Station
FIRE EXTINGUISHER	Mounted at each fire extinguisher, in OSHA red (1 Required) Central Zone Booster Pump Station
RESTROOM	Mounted Adjacent to Restroom Door Per Drawings

100700 SAFETY EQUIPMENT

This section of the Specifications includes miscellaneous safety equipment to be installed throughout job at various locations. The Contractor shall furnish and install all items specified in this section, including

bolts, caulking materials, hangers, supports, and such incidentals materials and equipment as are required to make the items complete and ready for use. All equipment shall conform to applicable OSHA requirements, and shall be installed in accordance with manufacturer's instructions.

100750 FIRE EXTINGUISHERS AND CABINETS

Fire prevention equipment locations shall be verified with the Engineer and Fire Marshall, and shall be installed where directed per NFPA Pamphlet No. 10. Provide instruction manual, giving information on operation, inspection and maintenance specific to the extinguisher provided.

Fire extinguishers shall be as manufactured by J.L. Industries; Standard Fire Hose Company; or equal.

Fire extinguishers shall be equal to Cosmic Model 10E, Fire Class ABC, 10 pound capacity, dry chemical, with UL rating of 4A-60 BNC. Extinguisher shall include a pressure indicating valve.

Extinguisher cabinets shall be similar to Clear Vu Series Model 1515, recess mounted with slim line 1-1/4 inch face trim of 18-gauge steel finished in semi-gloss white epoxy. Cabinet door shall be clear acrylic bubble with enameled steel trim. Each cabinet shall include one extinguisher as specified above.

Each extinguisher shall be provided with a Mark Series II extinguisher bracket, and shall be installed so that top of unit is not more than 5'-0" above the floor.

Fire extinguisher and cabinet quantities and locations shall be as indicated on the plans.

101204 SINKS

- A. Molded Resin:
 - 1. Cast or molded in one piece with interior corners 25 mm (one inch) minimum radius.
 - 2. Minimum thickness of sides and ends 13 mm (1/2 inch), bottom 16 mm (5/8 inch).
 - 3. Molded resin outlet for drain and standpipe overflow.
 - 4. Provide clamping collar permitting connection to 38 mm (1-1/2 inch) or 50 mm (2 inch) waste outlet and trap, making sealed but not permanent connection.
- B. Stainless Steel:
 - 1. ANSI/ASME A112.19.3, Type 304.
 - 2. Self rim for plastic laminate or similar tops with concealed fasteners.
 - 3. Flat rim for welded into stainless steel tops.
 - 4. Ledge back or ledge sides with holes to receive required fixtures when mounted on countertop.
 - 5. Apply fire resistant sound deadening material to underside.

101205 TRAPS AND FITTINGS

- A. Material as specified in DIVISION 22, PLUMBING.
- B. For Molded Resin Sinks:
 - 1. Chemical resisting P-traps and fittings for chemical waste service.
 - 2. Provide traps with cleanout plug easily removable without tools.
- C. For Stainless Steel Sinks:
 - 1. Either cast or wrought brass or stainless-steel P-traps and drain fittings; ASME A112.18.1
 - 2. Flat strainer, except where cup strainer or overflow standpipe specified.
 - a. Provide cup strainer in cabinet type 1B.

- b. Provide stainless steel overflow standpipe to within 38 mm (1-1/2 inches) of sink rim.
 - 3. Exposed surface chromium plated finish.
- D. Plaster traps:
 - 1. Cast iron body with porcelain enamel exterior finish.
 - 2. 50 mm (2 inch) female threaded side inlet and outlet.
 - 3. Removable galvanized cage having integral baffles and replaceable brass screens.
 - 4. Removable gasketed cover.
 - 5. Minimum overall dimensions: 350 x 350 x 400 mm high (14 x 14 x 16 inches) with 175 mm (7 inch) water seal.
 - 6. Non-siphoning and easily accessible for cleaning.
- E. Air Gap Fittings: ASME A112.1.2.

101206 WATER FAUCETS

- A. ASME A112.18.1.
 - 1. Cast or forged brass, compression type with replaceable seat and stem assembly or replaceable cartridge.
 - 2. Indexed four-arm lever handles either with or without head.
 - 3. Gooseneck minimum clearance above countertop of 190 mm (7-1/2 inches), bent 180 degrees for vertical discharge.
 - 4. Swing spouts elevated to clear handles.
 - 5. Exposed brass surfaces chromium plated.
 - 6. Cast combination hot and cold fixture with one piece body for multiple outlets.
 - 7. Adapter type connection which will permit field conversion of swing spouts to fixed or gooseneck grouts or vice versa.
 - 8. Pedestals Top for Laboratory or Pharmacy:
 - a. Modern design tapered to a round base, factory assembled and tested.
 - b. Brass shanks, locknuts and washers for attaching to top or curbs.
- B. Laminar flow control device on spouts.
- C. Automatic Controlled Faucets.
 - 1. Infra-red photocell sensor and a solenoid valve to control water flow automatically.
 - 2. Breaking light beam activates water flow.
 - 3. Water stops when user moves away from light beam.
- D. Eye and Face Wash Unit Pull-Out-Type:
 - 1. Deck mounted.
 - 2. Designed for vandal resistant push-down control valve and 6 foot hose.
 - 3. Eye and face wash head, provide a soft stream for flushing action.
 - 4. Valve, when opened; remain open until manually closed.
- E. Eye and Face Bath, Counter Mounted:
 - 1. Stainless Steel circular or oval shaped self-rimmed sink, as shown on drawings.
 - 2. Two fully enclosed rubber bound spray heads to provide an aerated flow of water simultaneously into both eyes and across face.
 - 3. Push-pull hand operated valve.
 - 4. Volume regulator for each spray.

101207 FIXTURE IDENTIFICATION

- A. Code fixtures with full view plastic index buttons.
- B. Use following colors and codes:

SERVICE	COLOR	CODE	COLOR OF LETTERS
Cold Water	Dark Green	CW	White
Hot Water	Red	HW	White
Laboratory Air	Orange	AIR	Black
Fuel Gas	Dark Blue	GAS	White
Laboratory Vacuum	Yellow	VAC	Black
Distilled Water	White	DW	Black
Deionized Water	White	DI	Black
Oxygen	Light Green	OXY	White
Hydrogen	Pink	H	Black
Nitrogen	Gray	N	Black
All Other Gases	Light Blue	CHEM.SYM.	Black

101209 INSTALLATION

- A. Before installing countertops verify that wall surfaces have been finished as specified and that mechanical and electrical service locations are as required.
- B. Secure countertops to supporting rails of cabinets with metal fastening devices, or screws through pierced slots in rails.
 - 1. Where type, size or spacing of fastenings is not shown or specified, submit shop drawings showing proposed fastenings and method of installation.
 - 2. Use round head bolts or screws.
 - 3. Use epoxy or silicone to fasten the epoxy resin countertops to the cabinets.
 - 4. Use wood or sheet metal screws for wood or plastic laminate tops; minimum penetration into top 16 mm (5/8 inch), screw size No 8, or 10.
- C. Rubber Moldings:
 - 1. Where shown install molding with butt joints in horizontal runs and mitered joints at corners where ceramic tile occurs omit molding.
 - 2. Fasten molding to wall and to splashbacks and splashends with adhesive.
- D. Sinks
 - 1. Install stainless steel sink in plastic laminate tops with epoxy compound to form watertight seal under shelf rim.
 - a. In laboratory and pharmacy fit stainless steel sink with overflow standpipe.
 - b. Install faucets and fittings on sink ledges with watertight seals where shown.
 - 2. Install molded resin sinks with epoxy compound to form watertight seal with underside of molded resin top.
 - a. Install sink with not less than two channel supports with threaded rods and nuts at each end, expansion bolted to molded resin top.
 - b. Design support for a twice the full sink weight.
 - c. Install with overflow standpipes.
- E. Faucets, Fixtures, and Outlets:
 - 1. Seal opening between fixture and top.
 - 2. Secure to top with manufacturers standard fittings.

101210 PROTECTION AND CLEANING

- A. Tightly cover and protect against dirt, water, and chemical or mechanical injury.

- B. Clean at completion of work.

101300 COMMON WORK RESULTS FOR PLUMBING

- A. The requirements of this Section shall apply to all sections of Division 22.
- B. Definitions:
1. Exposed: Piping and equipment exposed to view in finished rooms.
- C. Abbreviations/Acronyms:
1. ABS: Acrylonitrile Butadiene Styrene
 2. AISI: American Iron and Steel Institute
 3. AWG: American Wire Gauge
 4. BACnet: Building Automation and Control Network
 5. BSG: Borosilicate Glass Pipe
 6. CDA: Copper Development Association
 7. CO: Carbon Monoxide
 8. ---
 9. CPVC: Chlorinated Polyvinyl Chloride
 10. CR: Chloroprene
 11. CWP: Cold Working Pressure
 12. db(A): Decibels (A weighted)
 13. DDC: Direct Digital Control
 14. DISS: Diameter Index Safety System
 15. DWV: Drainage, Waste and Vent
 16. ECC: Engineering Control Center
 17. EPDM: Ethylene Propylene Diene Monomer
 18. EPT: Ethylene Propylene Terpolymer
 19. ETO: Ethylene Oxide
 20. FAR: Federal Acquisition Regulations
 21. FD: Floor Drain
 22. FG: Fiberglass
 23. FNPT: Female National Pipe Thread
 24. FPM: Fluoroelastomer Polymer
 25. HDPE: High Density Polyethylene
 26. HOA: Hands-Off-Automatic
 27. HP: Horsepower
 28. ID: Inside Diameter
 29. MAWP: Maximum Allowable Working Pressure
 30. NPTF: National Pipe Thread Female
 31. NPS: Nominal Pipe Size
 32. NPT: National Pipe Thread
 33. OD: Outside Diameter
 34. OSD: Open Sight Drain
 35. OS&Y: Outside Stem and Yoke
 36. PP: Polypropylene
 37. PTFE: Polytetrafluoroethylene
 38. PVC: Polyvinyl Chloride
 39. PVDF: Polyvinylidene Fluoride
 40. RTRP: Reinforced Thermosetting Resin Pipe
 41. SPS: Sterile Processing Services
 42. SUS: Saybolt Universal Second
 43. SWP: Steam Working Pressure

- 44. TFE: Tetrafluoroethylene
- 45. THHN: Thermoplastic High-Heat Resistant Nylon Coated Wire
- 46. THWN: Thermoplastic Heat & Water Resistant Nylon Coated Wire
- 47. USDA: U.S. Department of Agriculture
- 48. VAC: Voltage in Alternating Current
- 49. WOG: Water, Oil, Gas

101301 APPLICABLE PUBLICATIONS

- A. The publications listed below shall form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
ASME Boiler and Pressure Vessel Code -
BPVC Section IX-2013 Welding, Brazing, and Fusing Qualifications
B31.1-2012 Power Piping
- C. American Society for Testing and Materials (ASTM):
A36/A36M-2012 Standard Specification for Carbon Structural Steel
A575-96(R2013)e1 Standard Specification for Steel Bars, Carbon, Merchant Quality, M-
Grades
E84-2013a Standard Test Method for Surface Burning Characteristics of Building Materials
E119-2012a Standard Test Methods for Fire Tests of Building Construction and Materials
F1760-01(R2011) Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Non-
Pressure Plastic Pipe Having Reprocessed-Recycled Content
- D. International Code Council, (ICC):
IBC-2012 International Building Code
IPC-2012 International Plumbing Code
- E. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:
SP-58-2009 Pipe Hangers and Supports - Materials, Design, Manufacture, Selection,
Application and Installation
SP-69-2003 Pipe Hangers and Supports - Selection and Application
- F. Military Specifications (MIL):
P-21035B Paint High Zinc Dust Content, Galvanizing Repair (Metric)
- G. National Electrical Manufacturers Association (NEMA):
MG 1-2011 Motors and Generators
- H. National Fire Protection Association (NFPA):
51B-2014 Standard for Fire Prevention During Welding, Cutting and Other Hot Work
54-2012 National Fuel Gas Code
70-2011 National Electrical Code (NEC)
- I. NSF International (NSF):
5-2012 Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment
14-2012 Plastic Piping System Components and Related Materials
61-2012 Drinking Water System Components – Health Effects
372-2011 Drinking Water System Components – Lead Content
- J. Department of Veterans Affairs (VA):
PG-18-10 Plumbing Design Manual
PG-18-13-2011 Barrier Free Design Guide

101302 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 11, COMMON WORK RESULTS FOR PLUMBING", with applicable paragraph identification.
- C. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements and will fit the space available.
- D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- E. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- F. Installing Contractor shall provide lists of previous installations for selected items of equipment. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references.
- G. Manufacturer's Literature and Data: Manufacturer's literature shall be submitted under the pertinent section rather than under this section.
 - 4. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
 - 5. Wall, floor, and ceiling plates.
- H. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approvals will be made only by groups.
- I. Coordination Drawings: Complete consolidated and coordinated layout drawings shall be submitted for all new systems, and for existing systems that are in the same areas. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8 inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show the proposed location and adequate clearance for all equipment, controls, piping, pumps, valves and other items. All valves, trap primer valves, water hammer arrestors, strainers, and equipment requiring service shall be provided with an access door sized for the complete removal of plumbing device, component, or equipment. Equipment foundations shall not be installed until equipment or piping layout drawings have been approved. Detailed layout drawings shall be provided for all piping systems. In addition, details of the following shall be provided.
 - 1. Mechanical equipment rooms.
 - 2. Interstitial space.
 - 3. Hangers, inserts, supports, and bracing.
 - 4. Pipe sleeves.
 - 5. Equipment penetrations of floors, walls, ceilings, or roofs.
- J. Maintenance Data and Operating Instructions:
 - 1. Maintenance and operating manuals in accordance with Section 010000, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment. Include complete list indicating all components of the systems with diagrams of the internal wiring for each item of equipment.
 - 2. Include listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment shall be provided. The listing shall include belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

- K. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 220800 COMMISSIONING OF PLUMBING SYSTEMS.

101303 QUALITY ASSURANCE

A. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products for at least 5 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least 5 years.
2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 160 km (100 miles) of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, compressors, water heaters, critical instrumentation, computer workstation and programming shall be submitted for project record and inserted into the operations and maintenance manual.
3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
4. The products and execution of work specified in Division 22 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code shall apply. Any conflicts shall be brought to the attention of the Owner.
5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
6. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
8. Asbestos products or equipment or materials containing asbestos shall not be used.

B. Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:

1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
3. Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
4. All welds shall be stamped according to the provisions of the American Welding Society.

C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Owner prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

- D. Execution (Installation, Construction) Quality:
1. All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract documents shall be referred to the Owner for resolution. Printed copies or electronic files of manufacturer's installation instructions shall be provided to the Owner at least 10 working days prior to commencing installation of any item.
 2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to: all types of valves, filters and strainers, transmitters, and control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to the Owner for resolution.
 3. Complete layout drawings shall be required by Paragraph, SUBMITTALS. Construction work shall not start on any system until the layout drawings have been approved by VA.
 4. Installer Qualifications: Installer shall be licensed and shall provide evidence of the successful completion of at least five projects of equal or greater size and complexity. Provide tradesmen skilled in the appropriate trade.
 5. If an installation is unsatisfactory to the Owner, the Contractor shall Ownerrect the installation at no additional cost or additional time to the Government.
- E. Guaranty: Warranty of Construction, FAR clause 52.246-21.
- F. Plumbing Systems: IPC, International Plumbing Code. Unless otherwise required herein, perform plumbing work in accordance with the latest version of the IPC. For IPC codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall". Reference to the "code official" or "owner" shall be interpreted to mean the Owner.
- G. Cleanliness of Piping and Equipment Systems:
1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
 2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
 3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Government. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC). All filters, strainers, fixture faucets shall be flushed of debris prior to final acceptance.
 4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

101304 DELIVERY, STORAGE AND HANDLING

- A. Protection of Equipment:
1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
 2. Damaged equipment shall be replaced with an identical unit as determined and directed by the Owner. Such replacement shall be at no additional cost or additional time to the Government.
 3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.

4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

101305 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them on Auto-Cad version ____ provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- D. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

101306 MATERIALS FOR VARIOUS SERVICES

- A. Non-pressure PVC pipe shall contain a minimum of 25 percent recycled content. Steel pipe shall contain a minimum of 25 percent recycled content.
- B. Plastic pipe, fittings and solvent cement shall meet NSF 14 and shall bear the NSF seal "NSF-PW". Polypropylene pipe and fittings shall comply with NSF 14 and NSF 61. Solder or flux containing lead shall not be used with copper pipe.
- C. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF 61 or NSF 372.
- D. In-line devices such as water meters, building valves, check valves, stops, valves, fittings, tanks and backflow preventers shall comply with NSF 61 and NSF 372.
- E. End point devices such as drinking fountains, lavatory faucets, kitchen and bar faucets, ice makers supply stops, and end-point control valves used to dispense drinking water must meet requirements of NSF 61 and NSF 372.

101307 FACTORY-ASSEMBLED PRODUCTS

- A. Standardization of components shall be maximized to reduce spare part requirements.
- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
 1. All components of an assembled unit need not be products of same manufacturer.

2. Constituent parts that are alike shall be products of a single manufacturer.
 3. Components shall be compatible with each other and with the total assembly for intended service.
 4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly at no additional cost or time to the Government.
- C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, shall be the same make and model.

101308 COMPATIBILITY OF RELATED EQUIPMENT

- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

101307 EQUIPMENT AND MATERIALS IDENTIFICATION

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings, or shown in the maintenance manuals. Coordinate equipment and valve identification with facility maintenance staff. In addition, provide bar code identification nameplate for all equipment which will allow the equipment identification code to be scanned into the system for maintenance and inventory tracking. Identification for piping is specified in Section 099100, PAINTING.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 7 mm (3/16 inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING shall be permanently fastened to the equipment. Unit components such as water heaters, tanks, coils, filters, etc. shall be identified.
- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 7 mm (3/16 inch) high riveted or bolted to the equipment.
- D. Control Items: All temperature, pressure, and controllers shall be labeled and the component's function identified. Identify and label each item as they appear on the control diagrams.
- E. Valve Tags and Lists:
1. Plumbing: All valves shall be provided with valve tags and listed on a valve list (Fixture stops not included).
 2. Valve tags: Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 8 mm (1/4 inch) for service designation on 19 gage, 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
 3. Valve lists: Valve lists shall be created using a word processing program and printed on plastic coated cards. The plastic coated valve list card(s), sized 215 mm (8-1/2 inches) by 275 mm (11 inches) shall show valve tag number, valve function and area of control for each service or system. The valve list shall be in a punched 3-ring binder notebook. An additional copy of the valve list shall be mounted in picture frames for mounting to a wall. Owner shall instruct contractor where frames shall be mounted.
 4. A detailed plan for each floor of the building indicating the location and valve number for each valve shall be provided in the 3-ring binder notebook. Each valve location shall be identified with a color coded sticker or thumb tack in ceiling or access door.

101308 GALVANIZED REPAIR COMPOUND

- A. Mil. Spec. DOD-P-21035B, paint.

101309 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. In lieu of the paragraph which follows, suspended equipment support and restraints may be designed and installed in accordance with the International Building Code (IBC)
- B. Type Numbers Specified: For materials, design, manufacture, selection, application, and installation refer to MSS SP-58. For selection and application refer to MSS SP-69. Refer to Section 055000, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting.
- C. For Attachment to Concrete Construction:
 - 1. Concrete insert: Type 18, MSS SP-58.
 - 2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 100 mm (4 inches) thick when approved by the Owner for each job condition.
 - 3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 100 mm (4 inches) thick when approved by the Owner for each job condition.
- D. For Attachment to Steel Construction: MSS SP-58.
 - 1. Welded attachment: Type 22.
 - 2. Beam clamps: Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23 mm (7/8 inch) outside diameter.
- E. Attachment to Metal Pan or Deck: As required for materials specified in // Section 05 31 00, STEEL DECKING. Section 053600, COMPOSITE METAL DECKING.
- F. For Attachment to Wood Construction: Wood screws or lag bolts.
- G. Hanger Rods: Hot-rolled steel, ASTM A36/A36M or ASTM A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 40 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- H. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 43 mm by 43 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts.
 - 1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
 - 2. Guide individual pipes on the horizontal member of every other trapeze hanger with 8 mm (1/4 inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 15 mm (1/2 inch) galvanized steel bands, or insulated calcium silicate shield for insulated piping at each hanger.
- I. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. Refer to Section 220711, PLUMBING INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or insulated calcium silicate shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for insulated piping.
 - 1. General Types (MSS SP-58):
 - a. Standard clevis hanger: Type 1; provide locknut.
 - b. Riser clamps: Type 8.
 - c. Wall brackets: Types 31, 32 or 33.
 - d. Roller supports: Type 41, 43, 44 and 46.
 - e. Saddle support: Type 36, 37 or 38.
 - f. Turnbuckle: Types 13 or 15.
 - g. U-bolt clamp: Type 24.
 - h. Copper Tube:
 - 1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, copper-coated, plastic coated or taped with isolation tape to prevent electrolysis.

- 2) For vertical runs use epoxy painted, copper-coated or plastic coated riser clamps.
- 3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
- 4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.
- i. Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp. //Spring Supports (Expansion and contraction of vertical piping):
 - 1) Movement up to 20 mm (3/4 inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
 - 2) Movement more than 20 mm (3/4 inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator. //
- j. Spring hangers are required on all plumbing system pumps one horsepower and greater.
- 2. Plumbing Piping (Other Than General Types):
 - a. Horizontal piping: Type 1, 5, 7, 9, and 10.
 - b. Chrome plated piping: Chrome plated supports.
 - c. Hangers and supports in pipe chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration and compensate for all static and operational conditions.
 - d. Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 1.3 mm (18 gage) minimum.
- J. Pre-insulated Calcium Silicate Shields:
 - 1. Provide 360 degree water resistant high density 965 kPa (140 psig) compressive strength calcium silicate shields encased in galvanized metal.
 - 2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.
 - 3. Shield thickness shall match the pipe insulation.
 - 4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.
 - a. Shields for supporting cold water shall have insulation that extends a minimum of 25 mm (1 inch) past the sheet metal.
 - b. The insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS SP-69. To support the load, the shields shall have one or more of the following features: structural inserts 4138 kPa (600 psig) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36/A36M) wear plates welded to the bottom sheet metal jacket.
 - 5. Shields may be used on steel clevis hanger type supports, trapeze hangers, roller supports or flat surfaces.

101310 PIPE PENETRATIONS

- A. Pipe penetration sleeves shall be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays.
- B. Pipe penetration sleeve materials shall comply with all firestopping requirements for each penetration.
- C. To prevent accidental liquid spills from passing to a lower level, provide the following:
 - 1. For sleeves: Extend sleeve 50 mm (2 inch) above finished floor and provide sealant for watertight joint.
 - 2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.

3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.
- D. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges, with structural engineer prior approval. Any deviation from these requirements must receive prior approval of Owner.
- E. Sheet metal, plastic, or moisture resistant fiber sleeves shall be provided for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- F. Cast iron or zinc coated pipe sleeves shall be provided for pipe passing through exterior walls below grade. The space between the sleeve and pipe shall be made watertight with a modular or link rubber seal. The link seal shall be applied at both ends of the sleeve.
- G. Galvanized steel or an alternate black iron pipe with asphalt coating sleeves shall be for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel sleeve shall be provided for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, sleeves shall be connected with a floor plate.
- H. Brass Pipe Sleeves shall be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve shall be connected with a floor plate.
- I. Sleeve clearance through floors, walls, partitions, and beam flanges shall be 25 mm (1 inch) greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation plus 25 mm (1 inch) in diameter. Interior openings shall be caulked tight with firestopping material and sealant to prevent the spread of fire, smoke, water and gases.
- J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.
- K. Pipe passing through roof shall be installed through a 4.9 kg per square meter copper flashing with an integral skirt or flange. Skirt or flange shall extend not less than 200 mm (8 inches) from the pipe and set in a solid coating of bituminous cement. Extend flashing a minimum of 250 mm (10 inches) up the pipe. Pipe passing through a waterproofing membrane shall be provided with a clamping flange. The annular space between the sleeve and pipe shall be sealed watertight.

101311 ASBESTOS

- A. Materials containing asbestos are not permitted.

101312 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities. Equipment layout drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review.
- B. Manufacturer's published recommendations shall be followed for installation methods not otherwise specified.
- C. Operating Personnel Access and Observation Provisions: All equipment and systems shall be arranged to provide clear view and easy access, without use of portable ladders, for maintenance, testing and operation of all devices including, but not limited to: all equipment items, valves, backflow preventers, filters, strainers, transmitters, sensors, meters and control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown on the drawings shall not be changed nor reduced.

- D. Structural systems necessary for pipe and equipment support shall be coordinated to permit proper installation.
- E. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- F. Cutting Holes:
 - 1. Holes shall be located to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by Owner. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to Owner for approval.
 - 2. Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.
 - 3. Holes through concrete and masonry shall be cut by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by Owner where working area space is limited.
- G. Interconnection of Pneumatic Instrumentation and Controls: Generally, pneumatic interconnections are not shown but must be provided.
- H. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- I. Protection and Cleaning:
 - 1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Owner. Damaged or defective items in the opinion of the Owner, shall be replaced at no additional cost or time to the Government.
 - 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Pipe openings, equipment, and plumbing fixtures shall be tightly covered against dirt or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- J. Concrete and Grout: Concrete and shrink compensating grout 25 MPa (3000 psig) minimum, specified in Section 033000, CAST-IN-PLACE CONCRETE, shall be used for all pad or floor mounted equipment.

101313 CLEANING AND PAINTING

- A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section 099100, PAINTING.
- B. In addition, the following special conditions apply:
 - 1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Scratches, scuffs, and abrasions shall be repaired prior to applying prime and finish coats.
 - 2. The following Material and Equipment shall NOT be painted:
 - a. Motors, controllers, control switches, and safety switches.
 - b. Control and interlock devices.
 - c. Regulators.
 - d. Pressure reducing valves.
 - e. Control valves and thermostatic elements.
 - f. Lubrication devices and grease fittings.
 - g. Copper, brass, aluminum, stainless steel and bronze surfaces.

- h. Valve stems and rotating shafts.
 - i. Pressure gages and thermometers.
 - j. Glass.
 - k. Name plates.
- 3. Control and instrument panels shall be cleaned and damaged surfaces repaired. Touch-up painting shall be made with matching paint type and color obtained from manufacturer or computer matched.
 - 4. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same paint type and color as utilized by the pump manufacturer.
 - 5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats per Section 099100, Painting.
 - 6. The final result shall be a smooth, even-colored, even-textured factory finish on all items. The entire piece of equipment shall be repainted, if necessary, to achieve this. Lead based paints shall not be used.

101314 IDENTIFICATION SIGNS

- A. Laminated plastic signs, with engraved lettering not less than 7 mm (3/16 inch) high, shall be provided that designates equipment function, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.
- B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, and performance data shall be placed on factory built equipment.

101315 OPERATION AND MAINTENANCE MANUALS

- A. All new and temporary equipment and all elements of each assembly shall be included.
- B. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information shall be included.
- C. Manufacturer's installation, maintenance, repair, and operation instructions for each device shall be included. Assembly drawings and parts lists shall also be included. A summary of operating precautions and reasons for precautions shall be included in the Operations and Maintenance Manual.
- G. Trouble-shooting guide for the control system troubleshooting shall be inserted into the Operations and Maintenance Manual.
- H. The control system sequence of operation corrected with submittal review comments shall be inserted into the Operations and Maintenance Manual.
- I. Emergency procedures for shutdown and startup of equipment and systems.

101316 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four hours to instruct Owner's personnel in operation and maintenance of the system.

101317 GENERAL-DUTY VALVES FOR PLUMBING PIPING

- A. This section describes the requirements for general-duty valves for domestic water and sewer systems.

101318 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
 - A112.14.1-2003 Backwater Valves
- C. American Society of Sanitary Engineering (ASSE):
 - 1001-2008 Performance Requirements for Atmospheric Type Vacuum Breakers
 - 1003-2009 Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems
 - 1011-2004 Performance Requirements for Hose Connection Vacuum Breakers
 - 1013-2011 Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers
 - 1015-2011 Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies
 - 1017-2009 Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems
 - 1020-2004 Performance Requirements for Pressure Vacuum Breaker Assembly
 - 1035-2008 Performance Requirements for Laboratory Faucet Backflow Preventers
 - 1069-2005 Performance Requirements for Automatic Temperature Control Mixing Valves
 - 1070-2004 Performance Requirements for Water Temperature Limiting Devices
 - 1071-2012 Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment
- D. American Society for Testing and Materials (ASTM):
 - A126-2004(R2009) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - A276-2013a Standard Specification for Stainless Steel Bars and Shapes
 - A536-1984(R2009) Standard Specification for Ductile Iron Castings
 - B62-2009 Standard Specification for Composition Bronze or Ounce Metal Castings
 - B584-2013 Standard Specification for Copper Alloy Sand Castings for General Applications
- E. International Code Council (ICC):
 - IPC-2012 International Plumbing Code
- F. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
 - SP-25-2008 Standard Marking Systems for Valves, Fittings, Flanges and Unions
 - SP-67-2011 Butterfly Valves
 - SP-70-2011 Gray Iron Gate Valves, Flanged and Threaded Ends
 - SP-71-2011 Gray Iron Swing Check Valves, Flanged and Threaded Ends
 - SP-80-2013 Bronze Gate, Globe, Angle, and Check Valves
 - SP-85-2011 Gray Iron Globe & Angle Valves, Flanged and Threaded Ends
 - SP-110-2010 Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
- G. National Environmental Balancing Bureau (NEBB):
 - 7th Edition 2005 Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems
- H. NSF International (NSF):
 - 61-2012 Drinking Water System Components – Health Effects
 - 372-2011 Drinking Water System Components – Lead Content
- I. University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USC FCCCHR):
 - 9th Edition Manual of Cross-Connection Control

101319 SUBMITTALS

- C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. Ball Valves.
 - 2. Gate Valves.
 - 3. Butterfly Valves.
 - 4. Balancing Valves.
 - 5. Check Valves.
 - 6. Globe Valves.
 - 7. Water Pressure Reducing Valves and Connections.
 - 8. Backwater Valves.
 - 9. Backflow Preventers.
 - 10. Chainwheels.
 - 11. Thermostatic Mixing Valves.
- D. Test and Balance reports for balancing valves.
- E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:
 - 1. Include complete list indicating all components of the systems.
 - 2. Include complete diagrams of the internal wiring for each item of equipment.
 - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
 - 4. Piping diagrams of thermostatic mixing valves to be installed.
- F. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 220800, COMMISSIONING OF PLUMBING SYSTEMS.
- G. Submit training plans and instructor qualifications in accordance with the requirements of Section 220800, COMMISSIONING OF PLUMBING SYSTEMS.

101320 VALVES, GENERAL

- A. Asbestos packing and gaskets are prohibited.
- B. Bronze valves shall be made with dezincification resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc shall not be permitted.
- C. Valves in insulated piping shall have 50 mm or DN50 (2 inch) stem extensions and extended handles of non-thermal conductive material that allows operating the valve without breaking the vapor seal or disturbing the insulation. Memory stops shall be fully adjustable after insulation is applied.
- D. Exposed Valves over 65 mm or DN65 (2-1/2 inches) installed at an elevation over 3.6 m (12 feet) shall have a chain-wheel attachment to valve hand-wheel, stem, or other actuator.
- E. All valves used to supply potable water shall meet the requirements of NSF 61 and NSF 372.

101321 SHUT-OFF VALVES

- A. Cold, Hot and Re-circulating Hot Water:
 - 1. 50 mm or DN50 (2 inches) and smaller: Ball, MSS SP-110, Ball valve shall be full port three piece or two piece with a union design with adjustable stem package. Threaded stem designs are not allowed. The ball valve shall have a SWP rating of 1035 kPa (150 psig) and a CWP rating of 4138 kPa (600 psig). The body material shall be Bronze ASTM B584, Alloy C844. The ends shall be non-lead solder.

2. Less than 100 mm DN100 (4 inches): Butterfly shall have an iron body with EPDM seal and aluminum bronze disc. The butterfly valve shall meet MSS SP-67, type I standard. The butterfly valve shall have a SWP rating of 1380 kPa (200 psig). The valve design shall be lug type suitable for bidirectional dead-end service at rated pressure. The body material shall meet ASTM A536, ductile iron.
3. 100 mm DN100 (4 inches) and larger:
 - a. Class 125, OS&Y, Cast Iron Gate Valve. The gate valve shall meet MSS SP-70 type I standard. The gate valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall meet ASTM A126, grey iron with bolted bonnet, flanged ends, bronze trim, and positive-seal resilient solid wedge disc. The gate valve shall be gear operated for sizes under 200 mm or DN200 (8 inches) and crank operated for sizes 200 mm or DN200 (8 inches) and above.
 - b. Single flange, ductile iron butterfly valves: The single flanged butterfly valve shall meet the MSS SP-67 standard. The butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The butterfly valve shall be lug type, suitable for bidirectional dead-end service at rated pressure without use of downstream flange. The body material shall comply with ASTM A536 ductile iron. The seat shall be EPDM with stainless steel disc and stem.
 - c. Grooved end, ductile iron butterfly valves. The grooved butterfly valve shall meet the MSS SP-67 standard. The grooved butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall be epoxy coated ductile iron conforming to ASTM A536 with two piece stainless steel stem, //Buna-N//EPDM// encapsulated ductile iron disc, and EPDM seal. The butterfly valve shall be gear operated.
- B. Reagent Grade Water: Valves for reagent grade, reverse osmosis, or deionized water service shall be ball type of same material as used for pipe.

101322 BALANCING VALVES

- A. Hot Water Re-circulating, 75 mm or DN75 (3 inches) and smaller manual balancing valve shall be of bronze body, brass ball construction with glass and carbon filled TFE seat rings and designed for positive shutoff. The manual balancing valve shall have differential pressure read-out ports across the valve seat area. The read out ports shall be fitting with internal EPT inserts and check valves. The valve body shall have 8 mm or DN8 NPT (1/4 inch NPT) tapped drain and purge port. The valves shall have memory stops that allow the valve to close for service and then reopened to set point without disturbing the balance position. All valves shall have calibrated nameplates to assure specific valve settings.
- B. Larger than 75 mm or DN75 (3 inches): Manual balancing valves shall be of heavy duty cast iron flanged construction with 861 kPa (125 psig) flange connections. The flanged manual balancing valves shall have either a brass ball with glass and carbon filled TFE seal rings or fitted with a bronze seat, replaceable bronze disc with EPDM seal insert and stainless steel stem. The design pressure shall be 1200 kPa (175 psig) at 121 degrees C (250 degrees F).

101323 CHECK VALVES

- A. 75 mm or DN75 (3 inches) and smaller shall be Class 125, bronze swing check valves with non-metallic disc suitable for type of service. The check valve shall meet MSS SP-80 Type 4 standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a Y pattern horizontal body design with bronze body material conforming to ASTM B62, solder joints, and PTFE or TFE disc.
- B. 100 mm or DN100 (4 inches) and larger:

1. Check valves shall be Class 125, iron swing check valve with lever and weight closure control. The check valve shall meet MSS SP-71 Type I standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a clear or full waterway body design with gray iron body material conforming to ASTM A126, bolted bonnet, flanged ends, bronze trim.
2. All check valves on the discharge side of submersible sump pumps shall have factory installed exterior level and weight with sufficient weight to prevent the check valve from hammering against the seat when the sump pump stops.

101324 BACKFLOW PREVENTERS

- A. A backflow prevention assembly shall be installed at any point in the plumbing system where the potable water supply comes in contact with a potential source of contamination. The backflow prevention assembly shall be approved by the University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USCFCCC).
- B. The reduced pressure principle backflow prevention assembly shall be ASSE listed 1013 with full port OS&Y positive-seal resilient gate valves and an integral relief monitor switch. The main body and access cover shall be epoxy coated ductile iron conforming to ASTM A536 grade 4. The seat ring and check valve shall be the thermoplastic type suited for water service. The stem shall be stainless steel conforming to ASTM A276. The seat disc shall be the elastomer type suited for water service. The checks and the relief valve shall be accessible for maintenance without removing the device from the line. An epoxy coated wye type strainer with flanged connections shall be installed on the inlet. Reduced pressure backflow preventers shall be installed in the following applications.
 1. Deionizers.
 2. Sterilizers.
 3. Stills.
 4. Dialysis, Deionized or Reverse Osmosis Water Systems.
 5. Water make up to heating systems, cooling tower, chilled water system, generators, and similar equipment consuming water.
 6. Water service entrance from loop system.
 7. Dental equipment.
 8. Power washer.
 9. Medical equipment.
 10. Process equipment.
 11. Autopsy, on each hot and cold water outlet at each table or sink.
 12. Reclaimed water systems.
- C. The pipe applied or integral atmospheric vacuum breaker shall be ASSE listed 1001. The main body shall be cast bronze. The seat disc shall be the elastomer type suited for water service. The device shall be accessible for maintenance without removing the device from the service line. The installation shall not be in a concealed or inaccessible location or where the venting of water from the device during normal operation is deemed objectionable. Atmospheric vacuum breakers shall be installed in the following applications.
 1. Hose bibs and sinks with threaded outlets.
 2. Disposers.
 3. Showers (telephone/handheld type).
 4. Hydrotherapy units.
 5. All kitchen equipment, if not protected by air gap.
 6. Ventilating hoods with wash down system.
 7. Film processor.
 8. Detergent system.

9. Fume hoods.
 10. Glassware washers.
 11. Service sinks (integral with faucet only).
 12. Laundry tubs (integral with faucet only).
 13. Sitz baths.
- D. The hose connection vacuum breaker shall be ASSE listed 1011. The main body shall be cast brass with stainless steel working parts. The diaphragm and disc shall be the elastomer type suited for water service. The device shall permit the attachment of portable hoses to hose thread outlets. Hose connection vacuum breakers shall be installed in the following locations requiring non-continuous pressure:
1. Hose bibbs and wall hydrants.

101325 EXAMINATION

- A. Valve interior shall be examined for cleanliness, freedom from foreign matter, and corrosion. Special packing materials shall be removed, such as blocks, used to prevent disc movement during shipping and handling.
- B. Valves shall be operated in positions from fully open to fully closed. Guides and seats shall be examined and made accessible by such operations.
- C. Threads on valve and mating pipe shall be examined for form and cleanliness.
- D. Mating flange faces shall be examined for conditions that might cause leakage. Bolting shall be checked for proper size, length, and material. Gaskets shall be verified for proper size and that its material composition is suitable for service and free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

101326 INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Valves shall be located for easy access and shall be provide with separate support. Valves shall be accessible with access doors when installed inside partitions or above hard ceilings.
- C. Valves shall be installed in horizontal piping with stem at or above center of pipe.
- D. Valves shall be installed in a position to allow full stem movement.
- E. Install chain wheels on operators for ball, butterfly, gate and globe valves NPS 100 mm or DN100 (4 inches) and larger and more than 3.6 m (12 feet) above floor. Chains shall be extended to 1524 mm (60 inches) above finished floor.
- F. Check valves shall be installed for proper direction of flow and as follows:
 1. Swing Check Valves: In horizontal position with hinge pin level and on top of valve.
- G. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction. Locate backflow preventers in same room as connected equipment or system.
 1. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
- H. Install pressure gages on outlet of backflow preventers.
- I. Do not install bypass piping around backflow preventers.
- J. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets.
 1. Install thermometers if specified.

2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- K. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no cost to the Government.

101327 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Calibrated balancing valves.
 2. Master, thermostatic, water mixing valves.
 3. Manifold, thermostatic, water-mixing-valve assemblies.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

101328 ADJUSTING

- A. Valve packing shall be adjusted or replaced after piping systems have been tested and put into service but before final adjusting and balancing. Valves shall be replaced if persistent leaking occurs.
- B. Set field-adjustable flow set points of balancing valves and record data. Ensure recorded data represents actual measured or observed conditions. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.
- D. Testing and adjusting of balancing valves shall be performed by an independent NEBB Accredited Test and Balance Contractor. A final settings and flow report shall be submitted to the Owner.

101329 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four hours to instruct the Owner's Personnel in operation and maintenance of the system.

101330 GENERAL COMMISSIONING REQUIREMENTS

- A. This Section 101330 GENERAL COMMISSIONING REQUIREMENTS shall form the basis of the construction phase commissioning process and procedures. The Commissioning Agent shall add, modify, and refine the commissioning procedures, as approved by Owner, to suit field conditions and actual manufacturer's equipment, incorporate test data and procedure results, and provide detailed scheduling for all commissioning tasks.
- C. Where individual testing, adjusting, or related services are required in the project specifications and not specifically required by this commissioning requirements specification, the specified services shall be provided and copies of documentation, as required by those specifications shall be submitted to the Owner and the Commissioning Agent to be indexed for future reference.
- D. Where training or educational services for Owner are required and specified in other sections of the specifications, including but not limited to Division 7, Division 8, Division 21, Division 22, Division 23, Division 26, Division 27, Division 28, and Division 31 series sections of the specification, these services are intended to be provided in addition to the training and educational services specified herein.

- E. Commissioning is a systematic process of verifying that the building systems perform interactively according to the construction documents and the Owner’s operational needs. The commissioning process shall encompass and coordinate the system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. Commissioning during the construction and post-occupancy phases is intended to achieve the following specific objectives according to the contract documents:
1. Verify that the applicable equipment and systems are installed in accordance with the contract documents and according to the manufacturer's recommendations.
 2. Verify and document proper integrated performance of equipment and systems.
 3. Verify that Operations & Maintenance documentation is complete.
 4. Verify that all components requiring servicing can be accessed, serviced and removed without disturbing nearby components including ducts, piping, cabling or wiring.
 5. Verify that the Owner’s operating personnel are adequately trained to enable them to operate, monitor, adjust, maintain, and repair building systems in an effective and energy-efficient manner.
 6. Document the successful achievement of the commissioning objectives listed above.
- F. The commissioning process does not take away from or reduce the responsibility of the Contractor to provide a finished and fully functioning product.

101331 CONTRACTUAL RELATIONSHIPS

- D. The procedures outlined in this specification must be executed within the following limitations:
1. No communications (verbal or written) from the Commissioning Agent shall be deemed to constitute direction that modifies the terms of any contract between the Department of Veterans Affairs and the Contractor.
 2. Commissioning Issues identified by the Commissioning Agent will be delivered to the Resident Engineer and copied to the designated Commissioning Representatives for the Contractor and subcontractors on the Commissioning Team for information only in order to expedite the communication process. These issues must be understood as the professional opinion of the Commissioning Agent and as suggestions for resolution.
 3. In the event that any Commissioning Issues and suggested resolutions are deemed by the Resident Engineer to require either an official interpretation of the construction documents or require a modification of the contract documents, the Contracting Officer or Resident Engineer will issue an official directive to this effect.
 4. All parties to the Commissioning Process shall be individually responsible for alerting the Resident Engineer of any issues that they deem to constitute a potential contract change prior to acting on these issues.
 5. Authority for resolution or modification of design and construction issues rests solely with the Contracting Officer or Resident Engineer, with appropriate technical guidance from the Architect/Engineer and/or Commissioning Agent.

101332 SUMMARY

- A. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.

101333 ACRONYMS

List of Acronyms	
Acronym	Meaning
A/E	Architect / Engineer Design Team

List of Acronyms	
Acronym	Meaning
AHJ	Authority Having Jurisdiction
ASHRAE	Association Society for Heating Air Condition and Refrigeration Engineers
BOD	Basis of Design
BSC	Building Systems Commissioning
CCTV	Closed Circuit Television
CD	Construction Documents
CMMS	Computerized Maintenance Management System
CO	Contracting Officer (Owner)
COR	Contracting Officer's Representative (see also owner-RE)
COBie	Construction Operations Building Information Exchange
CPC	Construction Phase Commissioning
Cx	Commissioning
CxA	Commissioning Agent
CxM	Commissioning Manager
CxR	Commissioning Representative
DPC	Design Phase Commissioning
FPT	Functional Performance Test
GBI-GG	Green Building Initiative - Green Globes
HVAC	Heating, Ventilation, and Air Conditioning
LEED	Leadership in Energy and Environmental Design
NEBB	National Environmental Balancing Bureau
O&M	Operations & Maintenance
OPR	Owner's Project Requirements
PFC	Pre-Functional Checklist
PFT	Pre-Functional Test
SD	Schematic Design
SO	Site Observation
TAB	Test Adjust and Balance
USGBC	United States Green Building Council

101334 DEFINITIONS

Acceptance Phase Commissioning: Commissioning tasks executed after most construction has been completed, most Site Observations and Static Tests have been completed and Pre-Functional Testing has been completed and accepted. The main commissioning activities performed during this phase are verification that the installed systems are functional by conducting Systems Functional Performance tests and Owner Training.

Accuracy: The capability of an instrument to indicate the true value of a measured quantity.

Back Check: A back check is a verification that an agreed upon solution to a design comment has been adequately addressed in a subsequent design review

Basis of Design (BOD): The Engineer's Basis of Design is comprised of two components: the Design Criteria and the Design Narrative, these documents record the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements (OPR) and to satisfy applicable regulatory requirements, standards, and guidelines.

Benchmarks: Benchmarks are the comparison of a building's energy usage to other similar buildings and to the building itself.. For example, ENERGY STAR Portfolio Manager is a frequently used and nationally recognized building energy benchmarking tool.

Calibrate: The act of comparing an instrument of unknown accuracy with a standard of known accuracy to detect, correlate, report, or eliminate by adjustment any variation in the accuracy of the tested instrument.

COBie: Construction Operations Building Information Exchange (COBie) is an electronic industry data format used to transfer information developed during design, construction, and commissioning into the Computer Maintenance Management Systems (CMMS) used to operate facilities. See the Whole Building Design Guide website for further information (<http://www.wbdg.org/resources/cobie.php>)

Commissionability: Defines a design component or construction process that has the necessary elements that will allow a system or component to be effectively measured, tested, operated and commissioned

Commissioning Agent (CxA): The qualified Commissioning Professional who administers the Cx process by managing the Cx team and overseeing the Commissioning Process. Where CxA is used in this specification it means the Commissioning Agent, members of his staff or appointed members of the commissioning team. Note that LEED uses the term Commissioning Authority in lieu of Commissioning Agent.

Commissioning Checklists: Lists of data or inspections to be verified to ensure proper system or component installation, operation, and function. Verification checklists are developed and used during all phases of the commissioning process to verify that the Owner's Project Requirements (OPR) is being achieved.

Commissioning Design Review: The commissioning design review is a collaborative review of the design professionals design documents for items pertaining to the following: owner's project requirements; basis of design; operability and maintainability (O&M) including documentation; functionality; training; energy efficiency, control systems' sequence of operations including building automation system features; commissioning specifications and the ability to functionally test the systems.

Commissioning Issue: A condition identified by the Commissioning Agent or other member of the Commissioning Team that adversely affects the commissionability, operability, maintainability, or functionality of a system, equipment, or component. A condition that is in conflict with the Contract Documents and/or performance requirements of the installed systems and components. (See also – Commissioning Observation).

Commissioning Manager (CxM): A qualified individual appointed by the Contractor to manage the commissioning process on behalf of the Contractor.

Commissioning Observation: An issue identified by the Commissioning Agent or other member of the Commissioning Team that does not conform to the project OPR, contract documents or standard industry best practices. (See also Commissioning Issue)

Commissioning Plan: A document that outlines the commissioning process, commissioning scope and defines responsibilities, processes, schedules, and the documentation requirements of the Commissioning Process.

Commissioning Process: A quality focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems, components, and assemblies are planned, designed, installed, tested, can be operated, and maintained to meet the Owner's Project Requirements.

Commissioning Report: The final commissioning document which presents the commissioning process results for the project. Cx reports include an executive summary, the commissioning plan, issue log, correspondence, and all appropriate check sheets and test forms.

Commissioning Representative (CxR): An individual appointed by a sub-contractor to manage the commissioning process on behalf of the sub-contractor.

Commissioning Specifications: The contract documents that detail the objective, scope and implementation of the commissioning process as developed in the Commissioning Plan.

Commissioning Team: Individual team members whose coordinated actions are responsible for implementing the Commissioning Process.

Construction Phase Commissioning: All commissioning efforts executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

Contract Documents (CD): Contract documents include design and construction contracts, price agreements and procedure agreements. Contract Documents also include all final and complete drawings, specifications and all applicable contract modifications or supplements.

Construction Phase Commissioning (CPC): All commissioning efforts executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

Coordination Drawings: Drawings showing the work of all trades that are used to illustrate that equipment can be installed in the space allocated without compromising equipment function or access for maintenance and replacement. These drawings graphically illustrate and dimension manufacturers' recommended maintenance clearances. On mechanical projects, coordination drawings include structural steel, ductwork, major piping and electrical conduit and show the elevations and locations of the above components.

Data Logging: The monitoring and recording of temperature, flow, current, status, pressure, etc. of equipment using stand-alone data recorders.

Deferred System Test: Tests that cannot be completed at the end of the acceptance phase due to ambient conditions, schedule issues or other conditions preventing testing during the normal acceptance testing period.

Deficiency: See "Commissioning Issue".

Design Criteria: A listing of the Owner Design Criteria outlining the project design requirements, including its source. These are used during the design process to show the design elements meet the OPR.

Design Intent: The overall term that includes the OPR and the BOD. It is a detailed explanation of the ideas, concepts, and criteria that are defined by the owner to be important. The design intent documents are utilized to provide a written record of these ideas, concepts and criteria.

Design Narrative: A written description of the proposed design solutions that satisfy the requirements of the OPR.

Design Phase Commissioning (DPC): All commissioning tasks executed during the design phase of the project.

Environmental Systems: Systems that use a combination of mechanical equipment, airflow, water flow and electrical energy to provide heating, ventilating, air conditioning, humidification, and dehumidification for the purpose of human comfort or process control of temperature and humidity.

Executive Summary: A section of the Commissioning report that reviews the general outcome of the project. It also includes any unresolved issues, recommendations for the resolution of unresolved issues and all deferred testing requirements.

Functionality: This defines a design component or construction process which will allow a system or component to operate or be constructed in a manner that will produce the required outcome of the OPR.

Functional Test Procedure (FTP): A written protocol that defines methods, steps, personnel, and acceptance criteria for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

Industry Accepted Best Practice: A design component or construction process that has achieved industry consensus for quality performance and functionality. Refer to the current edition of the NEBB Design Phase Commissioning Handbook for examples.

Installation Verification: Observations or inspections that confirm the system or component has been installed in accordance with the contract documents and to industry accepted best practices.

Integrated System Testing: Integrated Systems Testing procedures entail testing of multiple integrated systems performance to verify proper functional interface between systems. Typical Integrated Systems Testing includes verifying that building systems respond properly to loss of utility, transfer to emergency power sources, re-transfer from emergency power source to normal utility source; interface between HVAC controls and Fire Alarm systems for equipment shutdown, interface between Fire Alarm system and elevator control systems for elevator recall and shutdown; interface between Fire Alarm System and Security Access Control Systems to control access to spaces during fire alarm conditions; and other similar tests as determined for each specific project.

Issues Log: A formal and ongoing record of problems or concerns – and their resolution – that have been raised by members of the Commissioning Team during the course of the Commissioning Process.

Lessons Learned Workshop: A workshop conducted to discuss and document project successes and identify opportunities for improvements for future projects.

Maintainability: A design component or construction process that will allow a system or component to be effectively maintained. This includes adequate room for access to adjust and repair the equipment. Maintainability also includes components that have readily obtainable repair parts or service.

Manual Test: Testing using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the ‘observation’).

Owner’s Project Requirements (OPR): A written document that details the project requirements and the expectations of how the building and its systems will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

Peer Review: A formal in-depth review separate from the commissioning review processes. The level of effort and intensity is much greater than a typical commissioning facilitation or extended commissioning review. The Owner usually hires an independent third-party (called the IDIQ A/E) to conduct peer reviews.

Precision: The ability of an instrument to produce repeatable readings of the same quantity under the same conditions. The precision of an instrument refers to its ability to produce a tightly grouped set of values around the mean value of the measured quantity.

Pre-Design Phase Commissioning: Commissioning tasks performed prior to the commencement of design activities that includes project programming and the development of the commissioning process for the project

Pre-Functional Checklist (PFC): A form used by the contractor to verify that appropriate components are onsite, correctly installed, set up, calibrated, functional and ready for functional testing.

Pre-Functional Test (PFT): An inspection or test that is done before functional testing. PFT’s include installation verification and system and component start up tests.

Procedure or Protocol: A defined approach that outlines the execution of a sequence of work or operations. Procedures are used to produce repeatable and defined results.

Range: The upper and lower limits of an instrument’s ability to measure the value of a quantity for which the instrument is calibrated.

Resolution: This word has two meanings in the Cx Process. The first refers to the smallest change in a measured variable that an instrument can detect. The second refers to the implementation of actions that correct a tested or observed deficiency.

Site Observation Visit: On-site inspections and observations made by the Commissioning Agent for the purpose of verifying component, equipment, and system installation, to observe contractor testing, equipment start-up procedures, or other purposes.

Site Observation Reports (SO): Reports of site inspections and observations made by the Commissioning Agent. Observation reports are intended to provide early indication of an installation issue which will need correction or analysis.

Special System Inspections: Inspections required by a local code authority prior to occupancy and are not normally a part of the commissioning process.

Static Tests: Tests or inspections that validate a specified static condition such as pressure testing. Static tests may be specification or code initiated.

Start Up Tests: Tests that validate the component or system is ready for automatic operation in accordance with the manufactures requirements.

Systems Manual: A system-focused composite document that includes all information required for the owners operators to operate the systems.

Test Procedure: A written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

Testing: The use of specialized and calibrated instruments to measure parameters such as: temperature, pressure, vapor flow, air flow, fluid flow, rotational speed, electrical characteristics, velocity, and other data in order to determine performance, operation, or function.

Testing, Adjusting, and Balancing (TAB): A systematic process or service applied to heating, ventilating and air-conditioning (HVAC) systems and other environmental systems to achieve and document air and hydronic flow rates. The standards and procedures for providing these services are referred to as “Testing, Adjusting, and Balancing” and are described in the Procedural Standards for the Testing, Adjusting and Balancing of Environmental Systems, published by NEBB or AABC.

Thermal Scans: Thermographic pictures taken with an Infrared Thermographic Camera. Thermographic pictures show the relative temperatures of objects and surfaces and are used to identify leaks, thermal bridging, thermal intrusion, electrical overload conditions, moisture containment, and insulation failure.

Training Plan: A written document that details, in outline form the expectations of the operator training. Training agendas should include instruction on how to obtain service, operate, startup, shutdown and maintain all systems and components of the project.

Trending: Monitoring over a period of time with the building automation system.

Unresolved Commissioning Issue: Any Commissioning Issue that, at the time that the Final Report or the Amended Final Report is issued that has not been either resolved by the construction team or accepted by the Owner. **Validation:** The process by which work is verified as complete and operating correctly:

1. First party validation occurs when a firm or individual verifying the task is the same firm or individual performing the task.
2. Second party validation occurs when the firm or individual verifying the task is under the control of the firm performing the task or has other possibilities of financial conflicts of interest in the resolution (Architects, Designers, General Contractors and Third Tier Subcontractors or Vendors).
3. Third party validation occurs when the firm verifying the task is not associated with or under control of the firm performing or designing the task.

Verification: The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner’s Project Requirements.

Warranty Phase Commissioning: Commissioning efforts executed after a project has been completed and accepted by the Owner. Warranty Phase Commissioning includes follow-up on verification of system performance, measurement and verification tasks and assistance in identifying warranty issues and enforcing warranty provisions of the construction contract.

Warranty Visit: A commissioning meeting and site review where all outstanding warranty issues and deferred testing is reviewed and discussed.

Whole Building Commissioning: Commissioning of building systems such as Building Envelope, HVAC, Electrical, Special Electrical (Fire Alarm, Security & Communications), Plumbing and Fire Protection as described in this specification.

101335 SYSTEMS TO BE COMMISSIONED

Plumbing	
Domestic Water Distribution	Booster pumps, backflow preventers, water softeners, potable water storage tanks
Domestic Hot Water Systems	Water heaters**, heat exchangers, circulation pumps, point-of-use water heaters*
Sanitary Waste Interceptors	Grease interceptors, acid neutralizers
Site Utilities	
Sanitary Sewerage Utilities	City Sanitary Connection, Waste Treatment Systems

101336 COMMISSIONING TEAM

- A. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project Superintendent and subcontractors, installers, schedulers, suppliers

101337 CONTRACTOR'S COMMISSIONING RESPONSIBILITIES

- A. The Contractor shall assign a Commissioning Manager to manage commissioning activities of the Contractor, and subcontractors.
- B. The Contractor shall ensure that the commissioning responsibilities outlined in these specifications are included in all subcontracts and that subcontractors comply with the requirements of these specifications.
- C. The Contractor shall ensure that each installing subcontractor shall assign representatives with expertise and authority to act on behalf of the subcontractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:
 - 1. Participate in commissioning coordination meetings.
 - 2. Conduct operation and maintenance training sessions in accordance with approved training plans.
 - 3. Verify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
 - 4. Evaluate commissioning issues and commissioning observations identified in the Commissioning Issues Log, field reports, test reports or other commissioning documents. In collaboration with entity responsible for system and equipment installation, recommend corrective action.
 - 5. Review and comment on commissioning documentation.
 - 6. Participate in meetings to coordinate Systems Functional Performance Testing.
 - 7. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to Commissioning Agent for incorporation into the commissioning plan.
 - 8. Provide information to the Commissioning Agent for developing commissioning plan.
 - 9. Participate in training sessions for Owner's operation and maintenance personnel.
 - 10. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures to conduct Systems Functional Performance Testing of installed systems.

101338 QUALITY ASSURANCE

- A. Instructor Qualifications: Factory authorized service representatives shall be experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.
- B. Test Equipment Calibration: The Contractor shall comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments. Instruments shall have been calibrated within six months prior to use.

101339 TEST EQUIPMENT

- A. The Contractor shall provide all standard and specialized testing equipment required to perform Systems Functional Performance Testing. Test equipment required for Systems Functional Performance Testing will be identified in the detailed System Functional Performance Test Procedure prepared by the Commissioning Agent.
- B. Data logging equipment and software required to test equipment shall be provided by the Contractor.

- C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5 °C (1.0 °F) and a resolution of + or - 0.1 °C (0.2 °F). Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and following any repairs to the equipment. Calibration tags shall be affixed or certificates readily available.

101340 DDC SYSTEM TRENDING FOR COMMISSIONING

Domestic Hot Water Trending and Alarms							
Point	Type	Trend Interval	Operational Trend Duration	Testing Trend Duration	Alarm Type	Alarm Range	Alar Delay
Domestic HW Setpoint WH-1	AI	15 Minute	12 Hours	3 days	N/A		
Domestic HW Setpoint WH-2	AI	15 Minute	12 Hours	3 days	N/A		
Domestic HW Temperature	AI	15 Minute	12 Hours	3 days	C	> 135 oF	10
Domestic HW Temperature	AI	15 Minute	12 Hours	3 days	P	±5°F from SP	10
Dom. Circ. Pump #1 Status	DI	COV	12 Hours	3 days	M	Status <> Command	30
Dom. Circ. Pump #2 Status	DI	COV	12 Hours	3 days	M	Status <> Command	30
Dom. Circ. Pump #1 Start/Stop	DO	COV	12 Hours	3 days	N/A		
Dom. Circ. Pump #2 Start/Stop	DO	COV	12 Hours	3 days	N/A		
Domestic HW Start/Stop	DO	COV	12 Hours	3 days	N/A		

101341 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

- A. This paragraph applies to Systems Functional Performance Testing of systems for all referenced specification Divisions.
- B. Objectives and Scope: The objective of Systems Functional Performance Testing is to demonstrate that each system is operating according to the Contract Documents. Systems Functional Performance Testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of noncompliant performance are identified and corrected, thereby improving the operation and functioning of the systems. In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load, fire alarm and emergency power) where there is a specified system response. The Contractor shall verify each sequence in the sequences of operation. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.
- C. Development of Systems Functional Performance Test Procedures: Before Systems Functional Performance Test procedures are written, the Contractor shall submit all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements found in the Contract Documents and approved submittals and shop drawings, the Commissioning Agent will develop specific Systems Functional Test Procedures to verify and document proper operation of each piece of equipment and system to be commissioned. The Contractor shall assist the Commissioning Agent in developing the Systems Functional Performance Test procedures as requested by the Commissioning Agent i.e. by answering questions about equipment, operation, sequences, etc. Prior to execution, the Commissioning Agent will provide a copy of the Systems Functional Performance Test procedures to the VA, the Architect/Engineer, and the Contractor, who shall review the tests for feasibility, safety, equipment and warranty protection.
- D. Purpose of Test Procedures: The purpose of each specific Systems Functional Performance Test is to verify and document compliance with the stated criteria of acceptance given on the test form. Representative test formats and examples are found in the Commissioning Plan for this project. (The Commissioning Plan is issued as a separate document and is available for review.) The test procedure forms developed by the Commissioning Agent will include, but not be limited to, the following information:
1. System and equipment or component name(s)
 2. Equipment location and ID number
 3. Unique test ID number, and reference to unique Pre-Functional Checklists and startup documentation, and ID numbers for the piece of equipment
 4. Date
 5. Project name
 6. Participating parties
 7. A copy of the specification section describing the test requirements
 8. A copy of the specific sequence of operations or other specified parameters being verified
 9. Formulas used in any calculations
 10. Required pretest field measurements
 11. Instructions for setting up the test.
 12. Special cautions, alarm limits, etc.
 13. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable format
 14. Acceptance criteria of proper performance with a Yes / No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved.
 15. A section for comments.
 16. Signatures and date block for the Commissioning Agent. A place for the Contractor to initial to signify attendance at the test.

- E. Test Methods: Systems Functional Performance Testing shall be achieved by manual testing (i.e. persons manipulate the equipment and observe performance) and/or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by standalone data loggers. The Contractor and Commissioning Agent shall determine which method is most appropriate for tests that do not have a method specified.
1. Simulated Conditions: Simulating conditions (not by an overwritten value) shall be allowed, although timing the testing to experience actual conditions is encouraged wherever practical.
 2. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
 3. Simulated Signals: Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
 4. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the Air Conditioning compressor lockout initiate at an outside air temperature below 12 C (54 F), when the outside air temperature is above 12 C (54 F), temporarily change the lockout setpoint to be 2 C (4 F) above the current outside air temperature.
 5. Indirect Indicators: Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification shall be completed during systems startup and initial checkout.
- F. Setup: Each function and test shall be performed under conditions that simulate actual conditions as closely as is practically possible. The Contractor shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Contractor shall return all affected building equipment and systems, due to these temporary modifications, to their pretest condition.
- G. Sampling: No sampling is allowed in completing Pre-Functional Checklists. Sampling is allowed for Systems Functional Performance Test Procedures execution. The Commissioning Agent will determine the sampling rate. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the Commissioning Agent may stop the testing and require the Contractor to perform and document a checkout of the remaining units, prior to continuing with Systems Functional Performance Testing of the remaining units.
- H. Cost of Retesting: The cost associated with expanded sample System Functional Performance Tests shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.
- I. Coordination and Scheduling: The Contractor shall provide a minimum of 7 days' notice to the Commissioning Agent and the Owner regarding the completion schedule for the Pre-Functional Checklists and startup of all equipment and systems. The Commissioning Agent will schedule Systems Functional Performance Tests with the Contractor and Owner. The Commissioning Agent will witness and document the Systems Functional Performance Testing of systems. The

Contractor shall execute the tests in accordance with the Systems Functional Performance Test Procedure.

- J. Testing Prerequisites: In general, Systems Functional Performance Testing will be conducted only after Pre-Functional Checklists have been satisfactorily completed. The control system shall be sufficiently tested and approved by the Commissioning Agent and the Owner before it is used to verify performance of other components or systems. The air balancing and water balancing shall be completed before Systems Functional Performance Testing of air-related or water-related equipment or systems are scheduled. Systems Functional Performance Testing will proceed from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems will be checked.
- K. Problem Solving: The Commissioning Agent will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the Contractor.

101342 DOCUMENTATION, NONCONFORMANCE AND APPROVAL OF TESTS

- A. Documentation: The Commissioning Agent will witness, and document the results of all Systems Functional Performance Tests using the specific procedural forms developed by the Commissioning Agent for that purpose. Prior to testing, the Commissioning Agent will provide these forms to the Owner and the Contractor for review and approval. The Contractor shall include the filled out forms with the O&M manual data.
- B. Nonconformance: The Commissioning Agent will record the results of the Systems Functional Performance Tests on the procedure or test form. All items of nonconformance issues will be noted and reported to the Owner on Commissioning Field Reports and/or the Commissioning Master Issues Log.
 - 1. Corrections of minor items of noncompliance identified may be made during the tests. In such cases, the item of noncompliance and resolution shall be documented on the Systems Functional Test Procedure.
 - 2. Every effort shall be made to expedite the systems functional Performance Testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the Commissioning Agent shall not be pressured into overlooking noncompliant work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so by direction from the Owner.
 - 3. As the Systems Functional Performance Tests progresses and an item of noncompliance is identified, the Commissioning Agent shall discuss the issue with the Contractor and the Owner.
 - 4. When there is no dispute on an item of noncompliance, and the Contractor accepts responsibility to correct it:
 - a. The Commissioning Agent will document the item of noncompliance and the Contractor's response and/or intentions. The Systems Functional Performance Test then continues or proceeds to another test or sequence. After the day's work is complete, the Commissioning Agent will submit a Commissioning Field Report to the Owner. The Commissioning Agent will also note items of noncompliance and the Contractor's response in the Master Commissioning Issues Log. The Contractor shall correct the item of noncompliance and report completion to the Owner and the Commissioning Agent.
 - b. The need for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test and the test shall be repeated.
 - 5. If there is a dispute about item of noncompliance, regarding whether it is an item of noncompliance, or who is responsible:

- a. The item of noncompliance shall be documented on the test form with the Contractor's response. The item of noncompliance with the Contractor's response shall also be reported on a Commissioning Field Report and on the Master Commissioning Issues Log.
 - b. Resolutions shall be made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive and acceptance authority is with the Department of Veterans Affairs.
 - c. The Commissioning Agent will document the resolution process.
 - d. Once the interpretation and resolution have been decided, the Contractor shall correct the item of noncompliance, report it to the Commissioning Agent. The requirement for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test. Retesting shall be repeated until satisfactory performance is achieved.
- C. Cost of Retesting: The cost to retest a System Functional Performance Test shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.
- D. Failure Due to Manufacturer Defect: If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform in compliance with the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance specifications, all identical units may be considered unacceptable by the Owner. In such case, the Contractor shall provide the Owner with the following:
- 1. Within one week of notification from the VA, the Contractor shall examine all other identical units making a record of the findings. The findings shall be provided to the Owner within two weeks of the original notice.
 - 2. Within two weeks of the original notification, the Contractor shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
 - 3. The Owner shall determine whether a replacement of all identical units or a repair is acceptable.
 - 4. Two examples of the proposed solution shall be installed by the Contractor and the Owner shall be allowed to test the installations for up to one week, upon which the Owner will decide whether to accept the solution.
 - 5. Upon acceptance, the Contractor shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.
- E. Approval: The Commissioning Agent will note each satisfactorily demonstrated function on the test form. Formal approval of the Systems Functional Performance Test shall be made later after review by the Commissioning Agent and by the Owner. The Commissioning Agent will evaluate each test and report to the Owner using a standard form. The Owner will give final approval on each test using the same form, and provide signed copies to the Commissioning Agent and the Contractor.

101343 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

- A. Training Preparation Conference: Before operation and maintenance training, the Commissioning Agent will convene a training preparation conference to include Owner's Resident Engineer, Owner's Operations and Maintenance personnel, and the Contractor. The purpose of this

conference will be to discuss and plan for Training and Demonstration of Owner Operations and Maintenance personnel.

- B. The Contractor shall provide training and demonstration. The Training and Demonstration shall include, but is not limited to, the following:
1. Review the Contract Documents.
 2. Review installed systems, subsystems, and equipment.
 3. Review instructor qualifications.
 4. Review instructional methods and procedures.
 5. Review training module outlines and contents.
 6. Review course materials (including operation and maintenance manuals).
 7. Review and discuss locations and other facilities required for instruction.
 8. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.
 9. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

101344 FACILITY SANITARY AND VENT PIPING

- A. This section pertains to sanitary sewer and vent systems, including piping, equipment and all necessary accessories as designated in this section.

101345 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
- A13.1-2007 Scheme for the Identification of Piping Systems
 - A112.36.2M-1991(R 2012) Cleanouts
 - A112.6.3-2001 (R2007) Standard for Floor and Trench Drains
 - B1.20.1-2013 Pipe Threads, General Purpose (Inch)
 - B16.1-2010 Gray Iron Pipe Flanges and Flanged Fittings
 - B16.4-2011 Standard for Grey Iron Threaded Fittings Classes 125 and 250
 - B16.15-2013 Cast Copper Alloy Threaded Fittings, Classes 125 and 250
 - B16.18-2012 Cast Copper Alloy Solder Joint Pressure Fittings
 - B16.21-2011 Nonmetallic Flat Gaskets for Pipe Flanges
 - B16.22-2013 Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
 - B16.23-2011 Cast Copper Alloy Solder Joint Drainage Fittings: DWV
 - B16.24-2001 (R2006) Cast Copper Alloy Pipe Flanges and Flanged Fittings
 - B16.29-2012 Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings: DWV
 - B16.39-2009 Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
 - B18.2.1-2012 Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
- C. American Society of Sanitary Engineers (ASSE):
- 1001-2008 Performance Requirements for Atmospheric Type Vacuum Breakers
 - 1018-2001 Performance Requirements for Trap Seal Primer Valves – Potable Water Supplied
 - 1044-2001 Performance Requirements for Trap Seal Primer Devices – Drainage Types and Electronic Design Types
 - 1079-2012 Performance Requirements for Dielectric Pipe Unions
- D. American Society for Testing and Materials (ASTM):
- A53/A53M-2012 Standard Specification for Pipe, Steel, Black And Hot-Dipped, Zinc-coated, Welded and Seamless

- A74-2013a Standard Specification for Cast Iron Soil Pipe and Fittings
- A888-2013a Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
- B32-2008 Standard Specification for Solder Metal
- B43-2009 Standard Specification for Seamless Red Brass Pipe, Standard Sizes
- B75-2011 Standard Specification for Seamless Copper Tube
- B88-2009 Standard Specification for Seamless Copper Water Tube
- B306-2013 Standard Specification for Copper Drainage Tube (DWV)
- B584-2013 Standard Specification for Copper Alloy Sand Castings for General Applications
- B687-1999 (R 2011) Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples
- B813-2010 Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
- B828-2002 (R 2010) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
- C564-2012 Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- D1785-2012 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- D2321-2011 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- D2564-2012 Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
- D2665-2012 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
- D2855-1996 (R 2010) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
- D5926-2011 Standard Specification for Poly(Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems
- F402-2005 (R 2012) Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
- F477-2010 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F1545-1997 (R 2009) Standard Specification for Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges
- E. Cast Iron Soil Pipe Institute (CISPI):
 - 2006 Cast Iron Soil Pipe and Fittings Handbook
 - 301-2012 Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
 - 310-2012 Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
- F. Copper Development Association, Inc. (CDA):
 - A4015 Copper Tube Handbook
- G. International Code Council (ICC):
 - IPC-2012 International Plumbing Code
- H. Manufacturers Standardization Society (MSS):
 - SP-123-2013 Non-Ferrous Threaded and Solder-Joint Unions for Use With Copper Water Tube
- I. National Fire Protection Association (NFPA):
 - 70-2011 National Electrical Code (NEC)
- J. Plumbing and Drainage Institute (PDI):
 - WH-201 (R 2010) Water Hammer Arrestors Standard
- K. Underwriters' Laboratories, Inc. (UL):
 - 508-99 (R2013) Standard For Industrial Control Equipment

101346 SUBMITTALS

- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. Piping.
 - 2. Floor Drains.
 - 3. Grease Removal Unit.
 - 4. Cleanouts.
 - 5. Trap Seal Protection.
 - 6. Penetration Sleeves.
 - 7. Pipe Fittings.
 - 8. Traps.
 - 9. Exposed Piping and Fittings.
- D. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

101347 SANITARY WASTE, DRAIN, AND VENT PIPING

- A. Cast iron waste, drain, and vent pipe and fittings.
 - 1. Cast iron waste, drain, and vent pipe and fittings shall be used for the following applications:
 - a. Pipe buried in or in contact with earth.
 - b. Sanitary pipe extensions to a distance of approximately 1500 mm (5 feet) outside of the building.
 - c. Interior waste and vent piping above grade.
 - 2. Cast iron Pipe shall be bell and spigot or hubless (plain end or no-hub or hubless).
 - 3. The material for all pipe and fittings shall be cast iron soil pipe and fittings and shall conform to the requirements of CISPI 301, ASTM A888, or ASTM A74.
 - 4. Cast iron pipe and fittings shall be made from a minimum of 95 percent post-consumer recycled material.
 - 5. Joints for hubless pipe and fittings shall conform to the manufacturer's installation instructions. Couplings for hubless joints shall conform to CISPI 310. Joints for hub and spigot pipe shall be installed with compression gaskets conforming to the requirements of ASTM C564.
- B. Copper Tube, (DWV):
 - 1. Copper DWV tube sanitary waste, drain and vent pipe may be used for piping above ground, except for urinal drains.
 - 2. The copper DWV tube shall be drainage type, drawn temper conforming to ASTM B306.
 - 3. The copper drainage fittings shall be cast copper or wrought copper conforming to ASME B16.23 or ASME B16.29.
 - 4. The joints shall be lead free, using a water flushable flux, and conforming to ASTM B32.
- C. Polyvinyl Chloride (PVC)
 - 1. Polyvinyl chloride (PVC) pipe and fittings are permitted where the waste temperature is below 60 degrees C (140 degrees F).
 - 2. PVC piping and fittings shall NOT be used for the following applications:
 - a. Waste collected from steam condensate drains.

- b. Spaces such as mechanical equipment rooms, kitchens, Sterile Processing Services, sterilizer areas, and areas designated for sleep.
 - c. Vertical waste and soil stacks serving more than two floors.
 - d. Exposed in mechanical equipment rooms.
 - e. Exposed inside of ceiling return plenums.
3. Polyvinyl chloride sanitary waste, drain, and vent pipe and fittings shall be solid core sewer piping conforming to ASTM D2665, sewer and drain series with ends for solvent cemented joints.
 4. Fittings: PVC fittings shall be solvent welded socket type using solvent cement conforming to ASTM D2564.

101348 EXPOSED WASTE PIPING

- A. Chrome plated brass piping of full iron pipe size shall be used in finished rooms for exposed waste piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
 1. The Pipe shall meet ASTM B43, regular weight.
 2. The Fittings shall conform to //ASME B16.15// //ASTM D2665//.
 3. Nipples shall conform to ASTM B687, Chromium-plated.
 4. Unions shall be brass or bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.
- B. In unfinished Rooms such as mechanical Rooms and Kitchens, Chrome-plated brass piping is not required. The pipe materials specified under the paragraph “Sanitary Waste, Drain, and Vent Piping” can be used. The sanitary pipe in unfinished rooms shall be painted as specified in Section 099100, PAINTING.

101349 SPECIALTY PIPE FITTINGS

- A. Transition pipe couplings shall join piping with small differences in outside diameters or different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear and corrosion resistant metal, tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:
 1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.
 2. For PVC soil pipes, the sleeve material shall be elastomeric seal or PVC, conforming to ASTM F477 or ASTM D5926.
 3. For dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.
- B. The dielectric fittings shall conform to ASSE 1079 with a pressure rating of 861 kPa (125 psig) at a minimum temperature of 82 degrees C (180 degrees F). The end connection shall be solder joint copper alloy and threaded ferrous.
- C. Dielectric flange insulating kits shall be of non-conducting materials for field assembly of companion flanges with a pressure rating of 1035 kPa (150 psig). The gasket shall be neoprene or phenolic. The bolt sleeves shall be phenolic or polyethylene. The washers shall be phenolic with steel backing washers.
- D. The di-electric nipples shall be electroplated steel nipple complying with ASTM F1545 with a pressure rating of 2070 kPa (300 psig) at 107 degrees C (225 degrees F). The end connection shall be male threaded. The lining shall be inert and noncorrosive propylene.

101350 CLEANOUTS

- A. Cleanouts shall be the same size as the pipe, up to 100 mm (4 inches); and not less than 100 mm (4 inches) for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. Minimum clearance of 600 mm (24 inches) shall be provided for clearing a clogged sanitary line.
- B. Floor cleanouts shall be gray iron housing with clamping device and round, secured, scoriated, gray iron cover conforming to ASME A112.36.2M. A gray iron ferrule with hubless, socket, inside calk or spigot connection and counter sunk, taper-thread, brass or bronze closure plug shall be included. The frame and cover material and finish shall be nickel-bronze copper alloy with a square shape. The cleanout shall be vertically adjustable for a minimum of 50 mm (2 inches). When a waterproof membrane is used in the floor system, clamping collars shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two way cleanouts shall be provided where indicated on drawings and at every building exit. The loading classification for cleanouts in sidewalk areas or subject to vehicular traffic shall be heavy duty type.
- C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel-bronze square frame and stainless steel cover with minimum opening of 150 by 150 mm (6 by 6 inches) shall be furnished at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed pipe, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required.
- D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/hubless cast iron ferrule. Plain end (hubless) piping in interstitial space or above ceiling may use plain end (hubless) blind plug and clamp.

101351 FLOOR DRAINS

- A. General Data: floor drain shall comply with ASME A112.6.3. A caulking flange, inside gasket, or hubless connection shall be provided for connection to cast iron pipe, screwed or no hub outlets for connection to steel pipe. The drain connection shall be bottom outlet. A membrane clamp and extensions shall be provided, if required, where installed in connection with waterproof membrane. Puncturing membrane other than for drain opening will not be permitted. Double drainage pattern floor drains shall have integral seepage pan for embedding into floor construction, and weep holes to provide adequate drainage from pan to drain pipe. For drains not installed in connection with a waterproof membrane, a .45 kg (16-ounce) soft copper, 1.1 to 1.8 Kg (2.5 to 4 lbs.) flashing membrane, 600 mm (24 inches) square or another approved waterproof membrane shall be provided.
- B. Type B (FD-B) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type B floor drain shall be constructed of galvanized cast iron with medium duty nickel bronze grate, double drainage pattern, clamping device, without sediment bucket but with secondary strainer in bottom for large debris. The grate shall be 175 mm (7 inches) minimum.
- C. Type C (FD-C) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type C floor drain shall have a cast iron body, double drainage pattern, clamping device, light duty nickel bronze adjustable strainer with round or square grate of 150 mm (6 inches) width or diameter minimum for toilet rooms, showers and kitchens.
- D. Type D (FD-D) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type D floor drain shall have a cast iron body with flange for membrane type flooring, integral reversible clamping device, seepage openings and 175 mm (7 inch) diameter or square satin nickel bronze or satin bronze strainer with 100 mm (4 inch) flange for toilet rooms, showers and kitchens.

- E. Type E (FD-E) floor drain shall comply with ASME A112.6.3. The type E floor drain shall have a heavy, cast iron body, double drainage pattern, heavy non-tilting // nickel bronze // ductile iron // grate not less than 300 mm (12 inches) square, removable sediment bucket. Clearance between body and bucket shall be ample for free flow of waste water. For traffic use, an extra heavy duty load classification ductile iron grate shall be provided.
- F. Type F (FD-F) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type F floor drain shall be have a cast iron body with flange, integral reversible clamping device, seepage openings and a 228 mm (9 inch) two-piece satin nickel-bronze or satin bronze strainer for use with seamless vinyl floors in toilet rooms and showers.
- G. Type G (FD-G) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type G floor drain shall have a cast iron body, shallow type with double drainage flange and removable, perforated aluminum sediment bucket. The type G drain shall have all interior and exposed exterior surfaces coated with acid resistant porcelain enamel finish. The floor drain shall have a clamping device. The frame and grate shall be nickel bronze. The grate shall be approximately 200 mm (8 inches) in diameter. The space between body of drain and basket shall be sufficient for free flow of waste water.
- H. Type H (FD-H) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type H drain shall have a cast iron body, double drainage pattern, without sediment bucket but with loose set nickel bronze grate, secondary strainer, and integral clamping collar. The grate shall be 300 mm (12 inches) in diameter or 300 mm (12 inches) square. The drain body shall be 150 mm (6 inches) deep.
- I. Type I (FD-I) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type I floor drain shall have a cast iron body, wide flange for seamless floor, double drainage pattern, with all interior surfaces and exposed exterior surfaces provided with acid resistant enamel finish for sanitary areas. The type I floor drain shall have a clamping device, secured nickel bronze rim, aluminum enameled finish sediment basket with, perforations with not less than 19,300 square mm (30 square inches) of free area. The sediment basket shall be approximately 100 mm (4 inches) deep, and be provided with grips for easy handling. The floor drain shall be provided with a loose-set, nickel bronze grate approximately 300 mm (12 inches) square and of sufficient strength to support pedestrian traffic. Ample space between body of drain and sediment basket shall be provided for free flow of waste liquids.
- J. Type J (FD-J) floor drain shall comply with ASME A112.6.3. The type J floor drain shall be a flushing rim drain with heavy duty cast iron body, double drainage pattern with flushing rim and clamping device. The nickel bronze grate shall be approximately 280 mm (11 inches) in diameter and flush with floor. A deep-seal P-trap shall be attached to drain. The body and trap shall have pipe taps for water supply connections.
1. Drain Flange: Flange for synthetic flooring.
 2. Flush Valve: Large diaphragm flushometer, exposed, side oscillating handle. For the flush valve mounting and installation detail, see the detail indicated on the drawings.
- K. Type K (FD-K) floor drain shall comply with ASME A112.6.3. The type K floor drain shall be a flushing Rim Drain with heavy duty cast iron body, double drainage pattern with flushing rim and clamping device. Solid bronze gasketed grate shall be approximately 280 mm (11 inches) in diameter, flush with floor. A deep-seal P-trap shall be attached to drain. Body and trap shall have pipe taps for water supply connections.
1. Drain Flange: Flange for synthetic flooring.
 2. Flush Valve: Large diaphragm flushometer, exposed, side oscillating handle.
- L. Type L (FD-L) floor drain shall comply with ASME A112.6.3. The type L floor drain shall be a flushing rim drain with heavy cast iron body, double drainage pattern with flushing rim and clamping device. Solid bronze gasketed grate shall be approximately 280 mm (11 inches) in diameter, with 50 mm (2 inch) length of 20 mm (3/4 inch) brass pipe brazed or threaded into the center of the solid grate. Pipe shall be threaded and provided with a brass cap with inter gasket

(neoprene) to provide a gas tight installation. A deep-seal P-trap shall be attached to drain. Body and trap shall have pipe taps for water supply connections. Used in dialysis rooms.

1. Drain Flange: Flange for synthetic flooring.
 2. Cystoscopy Rooms:
 - a. Flush Valve: The flush valves shall be large diaphragm type flushometer, solenoid operated with a single-circuit timer. Mount in valve cabinet.
 - b. Operation: Valve solenoid shall be cycled by a single-circuit timer set to operate flush valve at five minute intervals. Timer shall be electrically connected to an "on-off" toggle switch and be provided with pilot light. Timer and flush valve shall operate only when timer/valve switch is in the "on" position.
 - c. Valve Cabinets:
 - 1) General: Sheet metal not lighter than 1.6 mm thick (16 gauge), size as required, rigidly assembled with joints welded, and punched or drilled for passage of required pipes and services. Provide anchors for fastening cabinet in place. Front shall be flush with wall finish and shall have flush fitting, hinged doors, with latch. Door shall be arranged to not offer any obstruction when open.
 - 2) Doors and Trim: Flush with front of cabinet, constructed of not lighter than number 2.7 mm thick (12 gauge) steel. Doors shall open through 180 degrees and be provided with two butt hinges or continuous hinge. Latch shall be provided by manufacture of cabinet.
 - 3) Painting: Prime and finish painting is specified under Section 09 91 00, PAINTING.
- M. Type M (FD-M) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type M floor drain shall have a cast iron body, nickel bronze adjustable funnel strainer and clamping device. Funnel strainer shall consist of a perforated floor-level square or round grate and funnel extension for indirect waste. Cut-out grate below funnel. Minimum dimensions as follows:
1. Area of strainer and collar – 23,000 square mm (36 square inches).
 2. Height of funnel – 95 mm (3-3/4 inches).
 3. Diameter of lower portion of funnel – 50 mm (2 inches).
 4. Diameter of top portion of funnel – 100 mm (4 inches).
 5. Provide paper collars for construction purposes.
- N. Type N (FD-N) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type N floor drain shall have a cast iron body, wide flange for seamless floors, double drainage pattern, with all interior and exposed exterior surfaces provided with acid resistant enamel finish for sanitary areas. The type N floor drain shall have a clamping device, secured nickel bronze rim, aluminum enameled finish sediment basket, perforated with not less than 9,000 square mm (14 square inches) of free area and approximately 50 mm (2 inches) deep. The sediment bucket shall be provided with grips for easy handling. The loose-set, nickel bronze grate approximately 200 mm (8 inches) shall be round and of sufficient strength to support pedestrian traffic. Ample space between body of drain and sediment basket shall be provided for free flow of waste liquids.
- O. Type O (FD-O) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type O floor drain shall have a cast iron body, double drainage pattern, clamping device, less grate and sediment basket but with dome type secondary strainer. The drain shall be 300 mm (12 inches) in diameter or 300 mm (12 inches) square and approximately 150 mm (6 inches) deep. The interior and exposed exterior surfaces shall have an acid resisting, enamel finish for sanitary areas.
- P. Type P (FD-P) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3. The type P floor drain shall have a cast iron body, double drainage pattern, with all interior and exposed exterior surfaces provided with acid resistant enamel finish for sanitary areas. The type P floor drain shall have a clamping device, secured nickel bronze rim, an aluminum enameled finish sediment basket perforated with not less than 27,000 square mm (42 square inches) of free area and

approximately 100 mm (4 inches) deep. The sediment bucket shall be provided with grips for easy handling. The loose-set, nickel bronze grate shall be approximately 7,700 square mm (12 square inches) and of sufficient strength to support pedestrian traffic. Ample space between body of drain and sediment basket shall be provided for free flow of waste liquids.

- Q. Type R (FD-R) floor drain shall comply with ASME A112.6.3. The type R floor drain shall have a cast iron body, double drainage pattern and clamping device, less grate and sediment basket but with dome type secondary strainer. The drain shall be 200 mm (8 inches) in diameter or 200 mm (8 inches) square and approximately 150 mm (6 inches) deep. The interior and exposed exterior surfaces and rim shall have an acid resisting finish for indirect waste in sanitary areas.
- R. Type S (FD-S) floor sink shall comply with ASME A112.6.3. The type S floor sink shall be constructed from type 304 stainless steel and shall be 300 mm (12 inches) square, and 200 mm (8 inches deep). The interior surface shall be polished. The double drainage flange shall be provided with weep holes, internal dome strainer, and heavy duty non-tilting loose set grate. A clamping device shall be provided.
- S. Type T (FD-T) floor drain shall comply with ASME A112.6.3. The type T drain shall be Funnel Type, chemical resistant floor drain with integral p-trap. Double drainage pattern floor drain shall have an integral seepage pan for embedding in floor and weep holes to provide adequate drainage from pan to drain pipe. Floor drain shall be polypropylene, flame retardant, Schedule 40 or 80. An outlet of floor drain shall be suitable for properly jointing perforated or slotted floor-level grate and funnel extension. Cut-out grate below funnel. Minimum dimensions as follows:
1. Height of funnel – 95 mm (3-3/4 inches).
 2. Diameter of lower portion of funnel – 50 mm (2 inches).
 3. Diameter of top portion of funnel – 100 mm (4 inches).
- T. Type V (FD-V) medium duty (non-traffic) floor drain shall comply with ASME A112.6.3 The type V floor drain shall have an oval funnel and cast iron body. Funnel strainer shall consist of a slotted cast iron floor-level grate funnel extension. Cut-out grate below funnel. Minimum dimensions as follows:
1. Area of strainer and collar – 23,000 square mm (36 square inches).
 2. Height of funnel – 95 mm (3-3/4 inches).
 3. Funnel size - 90 by 228 mm (3-1/2 by 9 inches).
- U. Type W (FD-W) Open Sight Drains (OSDs) for clear water wastes only:
1. OSD's shall be the cast iron open hub type.
 2. A cast iron drain standpipe shall be utilized for equipment with a high rate of discharge.
- V. Type X (FD-X) floor drain shall comply with ASME A112.6.3. The type X floor drain shall be a chemical resistant floor drain and integral p-trap. Double drainage pattern floor drain shall have integral seepage pan for embedding in floor and weep holes to provide adequate drainage from pan to drain pipe. Floor drain shall be polypropylene, flame retardant, Schedule 40 or 80. An outlet of floor drain shall be suitable for properly joining a perforated or slotted floor level grate.
- W. Type Y (FD-Y) floor drain shall comply with ASME A112.6.3. The type Y floor drain shall be suitable for parking decks and constructed of extra heavy duty, galvanized cast iron body with double drainage pattern. The extra heavy duty polished bronze grate shall be not less than 228 mm (9 inches) in diameter with seepage pan and combination membrane flashing clamp, heavy duty support flange, under deck clamp and vandal proof grate.

101352 TRAPS

- A. Traps shall be provided on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed brass shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps may be rough cast brass or same material as the piping they are connected to. Slip joints are not permitted on sewer side of trap. Traps shall correspond to fittings

on cast iron soil pipe or steel pipe respectively, and size shall be as required by connected service or fixture.

101353 PENETRATION SLEEVES

- A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that will extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that will extend through the floor slab. A waterproof caulked joint shall be provided at the top hub.

101354 PIPE INSTALLATION

- A. The pipe installation shall comply with the requirements of the International Plumbing Code (IPC) and these specifications.
- B. Branch piping shall be installed for waste from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
- C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.
- D. All pipe runs shall be laid out to avoid interference with other work.
- E. The piping shall be installed above accessible ceilings where possible.
- F. The piping shall be installed to permit valve servicing or operation.
- G. The piping shall be installed free of sags and bends.
- H. Seismic restraint shall be installed where required by code.
- I. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- J. Buried soil and waste drainage and vent piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer's written instruction for use of lubricants, cements, and other installation requirements.
- K. Cast iron piping shall be installed according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings"
- L. Aboveground copper tubing shall be installed according to Copper Development Association's (CDA) "Copper Tube Handbook".
- M. Aboveground PVC piping shall be installed according to ASTM D2665. Underground PVC piping shall be installed according to ASTM D2321.

101355 JOINT CONSTRUCTION

- A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

- B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- C. Hubless or No-hub, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.
- D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service.
 - 2. Pipe sections with damaged threads shall be replaced with new sections of pipe.
- E. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead free alloy solder conforming to ASTM B32 shall be used.
- F. For PVC piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2855 and ASTM D2665 appendixes.

101356 PIPE HANGERS, SUPPORTS AND ACCESSORIES

- A. All piping shall be supported according to the International Plumbing Code (IPC), Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications. Where conflicts arise between these the code and Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING the most restrictive or the requirement that specifies supports with highest loading or shortest spacing shall apply.
- B. Hangers, supports, rods, inserts and accessories used for pipe supports shall be painted according to Section 09 91 00, PAINTING. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
- C. Horizontal piping and tubing shall be supported within 300 mm (12 inches) of each fitting or coupling.
- D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:
 - 1. 40 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 inch to NPS 2 inch): 1500 mm (60 inches) with 10 mm (3/8 inch) rod.
 - 2. 75 mm or DN75 (NPS 3 inch): 1500 mm (60 inches) with 15 mm (1/2 inch) rod.
 - 3. 100 mm or DN100 to 125 mm or DN125 (NPS 4 inch to NPS 5 inch): 1500 mm (60 inches) with 18 mm (5/8 inch) rod.
 - 4. 150 mm or DN150 to 200 mm or DN200 (NPS 6 inch to NPS 8 inch): 1500 mm (60 inches) with 20 mm (3/4 inch) rod.
 - 5. 250 mm or DN250 to 300 mm or DN300 (NPS 10 inch to NPS 12 inch): 1500 mm (60 inch) with 23 mm (7/8 inch) rod.
- E. The maximum spacing for plastic pipe shall be 1.22 m (4 feet).//
- F. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.6 m (15 feet).
- G. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, Floor, Wall and Ceiling Plates, Supports, Hangers shall have the following characteristics:
 - 1. Solid or split unplated cast iron.
 - 2. All plates shall be provided with set screws.
 - 3. Height adjustable clevis type pipe hangers.
 - 4. Adjustable floor rests and base flanges shall be steel.

5. Hanger rods shall be low carbon steel, fully threaded or threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
 6. Riser clamps shall be malleable iron or steel.
 7. Rollers shall be cast iron.
 8. See Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, for requirements on insulated pipe protective shields at hanger supports.
- H. Miscellaneous materials shall be provided as specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6.1 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. All necessary auxiliary steel shall be provided to provide that support.
- I. Cast escutcheon with set screw shall be provided at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- J. Penetrations:
1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 078400, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.
 2. Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and make watertight with sealant as specified in Section 079200, JOINT SEALANTS.
- K. Exhaust vents shall be extended separately through roof. Sanitary vents shall not connect to exhaust vents.

101357 TESTS

- A. Sanitary waste and drain systems shall be tested either in its entirety or in sections.
- B. Waste System tests shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted, as directed.
1. If entire system is tested for a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If the waste system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
 2. For an air test, an air pressure of 34 kPa (5 psig) gage shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gage shall be used for the air test.
 3. After installing all fixtures and equipment, open water supply so that all p-traps can be observed. For 15 minutes of operation, all p-traps shall be inspected for leaks and any leaks found shall be corrected.
 4. Final Tests: Either one of the following tests may be used.
 - a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of .25 kPa (1 inch of water) with a smoke machine. Chemical smoke is prohibited.
 - b. Peppermint Test: Introduce 60 ml (2 ounces) of peppermint into each line or stack.

101358 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 220800, COMMISSIONING OF PLUMBING SYSTEMS.

101359 PLUMBING FIXTURES

- A. Plumbing fixtures, associated trim and fittings necessary to make a complete installation from wall or floor connections to rough piping, and certain accessories.

101360 SUBMITTALS

- B. Submit plumbing fixture information in an assembled brochure, showing cuts and full detailed description of each fixture.

101361 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standard Institute (ANSI):
The American Society of Mechanical Engineers (ASME):
A112.6.1M-02(R2008) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
A112.19.1M-08 Enameled Cast Iron Plumbing Fixtures
A112.19.2M-03 Vitreous China Plumbing Fixtures
A112.19.3-2001(R2008) Stainless Steel Plumbing Fixtures (Designed for Residential Use)
- C. American Society for Testing and Materials (ASTM):
A276-2010 Stainless and Heat-Resisting Steel Bars and Shapes
WW-P-541-E/GEN Plumbing Fixtures with Amendment 1
- D. National Association of Architectural Metal Manufacturers (NAAMM): NAAMM AMP 500-505 Metal Finishes Manual (1988)
- E. American Society of Sanitary Engineers (ASSE):
1016-05 Performance Requirements for Individual Thermostatic, Pressure Balancing and Combination Pressure Balancing and Thermostatic Control Valves for Individual Fixture Fittings
- F. NSF International (NSF)
NSF/ANSI 14 (2013) Plastics Piping System Components and Related Materials
NSF/ANSI 61 (2012) Drinking Water System Components – Health Effects
NSF/ANSI 372 (2011) Drinking Water System Components – Lead Content
- G. American with Disabilities Act (A.D.A) Section 4-19.4 Exposed Pipes and Surfaces
- H. Environmental Protection Agency EPA PL 93-523 1974; A 1999) Safe Drinking Water Act.
- I. International Building Code, ICC IPC 2012.

101362 MATERIALS

- A. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF/ANSI 61 or NSF 372. Endpoint devices used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9.
- B. Plastic pipe, fittings, and solvent cement shall meet NSF/ANSI 14 and shall be NSF listed for the service intended.

101363 STAINLESS STEEL

- A. Corrosion-resistant Steel (CRS):
 - 1. Plate, Sheet and Strip: CRS flat products shall conform to chemical composition requirements of any 300 series steel specified in ASTM A276.
 - 2. Finish: Exposed surfaces shall have standard polish (ground and polished) equal to NAAMM finish Number 4.
- B. Die-cast zinc alloy products are prohibited.

101364 STOPS

- A. Provide lock-shield loose key or screw driver pattern angle stops, straight stops or stops integral with faucet, with each compression type faucet whether specifically called for or not, including sinks in wood and metal casework, laboratory furniture and pharmacy furniture. Locate stops centrally above or below fixture in accessible location.
 - B. Furnish keys for lock shield stops to Resident Engineer.
- C. Supply from stops not integral with faucet shall be chrome plated copper flexible tubing or flexible stainless steel with inner core of non-toxic polymer.
- D. Supply pipe from wall to valve stop shall be rigid threaded IPS copper alloy pipe, i.e. red brass pipe nipple, chrome plated where exposed.
- E. Psychiatric Area: Provide stainless steel drain guard for all lavatories not installed in casework.

101365 ESCUTCHEONS

Heavy type, chrome plated, with set screws. Provide for piping serving plumbing fixtures and at each wall, ceiling and floor penetrations in exposed finished locations and within cabinets and millwork.

101366 LAMINAR FLOW CONTROL DEVICE

- A. Smooth, bright stainless steel or satin finish, chrome plated metal laminar flow device shall provide non-aeration, clear, coherent laminar flow that will not splash in basin. Device shall also have a flow control restrictor and have vandal resistant housing.
- B. Flow Control Restrictor:
 - 1. Capable of restricting flow from 95 ml/s to 110 ml/s (1.5 gpm to 1.7 gpm) for lavatories; 125 ml/s to 140 ml/s (2.0 gpm to 2.2 gpm) for sinks P-505 through P-520, P-524 and P-528; and 170 ml/s to 190 ml/s (2.75 gpm to 3.0 gpm) for dietary food preparation and rinse sinks or as specified.
 - 2. Compensates for pressure fluctuation maintaining flow rate specified above within 10 percent between 170 kPa and 550 kPa (25 psi and 80 psi).
 - 3. Operates by expansion and contraction, eliminates mineral/sediment build-up with self-cleaning action, and is capable of easy manual cleaning.

101366 CARRIERS

- A. ASME/ANSI A112.6.1M, with adjustable gasket faceplate chair carriers for wall hung closets with auxiliary anchor foot assembly, hanger rod support feet, and rear anchor tie down.

- B. ASME/ANSI A112.6.1M, lavatory, // chair carrier for thin wall construction // steel plate as detailed on drawing. // All lavatory chair carriers shall be capable of supporting the lavatory with a 250-pound vertical load applied at the front of the fixture.
- C. Where water closets, lavatories or sinks are installed back-to-back and carriers are specified, provide one carrier to serve both fixtures in lieu of individual carriers. The drainage fitting of the back to back carrier shall be so constructed that it prevents the discharge from one fixture from flowing into the opposite fixture.

101367 WATER CLOSETS

- A. (P-101) Water Closet (Floor Mounted, ANSI 112.19.2M, Figure 6)-office and industrial, elongated bowl, siphon jet 6 L (1.6 gallons) per flush, floor outlet. Top of rim shall be 435 mm to 438 mm (17 1/8 inches to 17 1/4 inches) above finished floor.
 - 1. Seat: Institutional/Industrial, extra heavy duty, chemical resistant, solid plastic, open front less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Seat shall be posture contoured body design. Color shall be white.
 - 2. Fittings and Accessories: Floor flange fittings-cast iron; Gasket-wax; bolts with chromium plated cap nuts and washers.
 - 3. Flush valve: Large chloramines resistant diaphragm, semi-red brass valve body, exposed chrome plated, non-hold-open ADA approved side oscillating handle battery powered active infra-red sensor for automatic operation with courtesy flush button for manual operation, water saver design 6 L (1.6 gallons) per flush with maximum 10 percent variance, top spud connection, adjustable tailpiece, one-inch IPS screwdriver back check angle stop with vandal resistant cap, high back pressure vacuum breaker, and sweat solder adapter with cover tube and cast set screw wall flange. Set centerline of inlet 292 mm (11 1/2 inches) above rim. Seat bumpers shall be integral part of flush valve. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM Alloy classification for semi-red brass.
- B. (P-102) Water Closet (Floor Mounted With Bedpan Washer ASME/ANSI A112.19.2M, Figure 6) floor outlet or wall outlet, with bed pan lugs-bedpan washer, flush valve operated, 6 L (1.6 gallons) per flush. Top of rim shall be 457 mm (18 inches) above finished floor. Provide standoff bracket support between studs for bedpan washer at height as recommended by manufacturer.
 - 1. Seat: Institutional/Industrial, extra heavy duty, chemical resistant, solid plastic, open front less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Seat shall be posture contoured body design. Color shall be white.
 - 2. Fittings and Accessories: Floor Flange fittings-cast iron; gaskets-wax; bolts with chromium plated cap nuts and washers.
 - 3. Flush valve: Large chloramines resistant diaphragm, semi-red brass valve body, exposed chrome plated, non-hold-open, ADA approved side oscillating handle battery powered active infra-red sensor for automatic operation with courtesy flush button for flush with maximum 10 percent variance, offset top spud connection, adjustable tailpiece, one-inch IPS screwdriver back check angle stop with vandal resistant cap, sweat solder adapter with cover tube and cast set screw wall flange, and high back pressure vacuum breaker. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM Alloy classification for semi-red brass. Set centerline of inlet 673 mm (26 1/2 inches) above rim. Seat bumpers shall be set in wall behind fixture at proper contact height.
- C. (P-103) Water Closet (Wall Hung, ASME/ANSI A112.19.2M, Figure 9) office and industrial, elongated bowl, siphon jet 6 L (1.6 gallons) per flush, wall outlet. Top of rim shall be between 406 mm and 432 mm (16 inches and 17 inches) above finished floor. Handicapped water closet shall have rim set 457 mm (18 inches) above finished floor.

1. Seat: Institutional/Industrial, extra heavy duty, chemical resistant, solid plastic, open front less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Seat shall be posture contoured body design. Color shall be white.
 2. Fittings and Accessories: Gaskets-neoprene; bolts with chromium plated caps nuts and washers.
 3. Flush valve: Large chloramines resistant diaphragm, semi-red brass valve body, exposed chrome plated, non-hold open ADA approved side oscillating handle, battery powered active infra-red sensor for automatic operation with courtesy flush button for manual operation sensor operated with manual override water saver design 6 L (1.6 gallons) per flush with maximum 10 percent variance 25 mm (1 inch) screwdriver back check angle stop with vandal resistant cap, adjustable tailpiece, a high back pressure vacuum breaker, spud coupling for 38 mm (1 1/2 inches) top spud, wall and spud flanges, and sweat solder adapter with cover tube and set screw wall flange. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM alloy classification for semi-red brass. Seat bumpers shall be integral part of flush valve. Set centerline of inlet 292 mm (11 1/2 inches) above rim.
- D. (P-104) Water Closet (Wall Hung with Bedpan Washer, ASME/ANSI A112.19.2M, Figure 9) elongated bowl, siphon jet, wall outlet, with bedpan lugs-bedpan washer with grab bar offset, flush valve operated 6 L (1.6 gallons) per flush. Top of rim shall be 457 mm (18 inches) above finished floor. Provide standoff bracket support between studs for bedpan washer at height recommended by the manufacturer.
1. Seat: Institutional/Industrial, extra heavy duty, chemical resistant, solid plastic, open front less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Seat shall be posture contoured body design. Color shall be white.
 2. Fittings and Accessories: Gaskets-neoprene; bolts with chromium plated cap nuts and washers.
 3. Flush valve: Large chloramines resistant diaphragm, semi-red brass valve body, exposed chrome plated, water saver design 6L (1.6 gallons) per flush with maximum 10 percent variance, non-hold-open ADA approved operating side oscillating handle, 25 mm (1 inch) IPS screwdriver back check angle stop with vandal resistant cap, adjustable tailpiece, high back pressure vacuum breaker, offset spud coupling for 38 mm (1 1/2 inches) top spud, cast screw wall and spud flanges, sweat solder adapter with cover tube and wall support at diverter valve body. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM alloy classification for semi-red brass. Set centerline of inlet 673 mm (26 1/2 inches) above rim.
- E. (P-105) Water Closet (Wall Hung, with Bedpan Lugs ASME/ANSI A112.19.2M, Figure 8) elongated bowl with siphon jet 6 L (1.6 gallons) per flush, with bedpan lugs- wall outlet. Top of rim shall be 457 mm (18 inches) above finished floor.
1. Seats: Institutional/Industrial, extra heavy duty, chemical resistant, solid plastic, open front less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Seat shall be posture contoured body design. Color shall be white.
 2. Fittings and Accessories: Gaskets-neoprene; bolts with chromium plated cap nuts and washers.
 3. Flush valve: Large chloramines resistant diaphragm, semi-red brass valve body, exposed chrome plated, non-hold-open ADA approved side oscillating handle, 25 mm (1 inch) IPS screwdriver back check angle stop with vandal resistant cap, high pressure vacuum breaker, water saver design 6 L (1.6 gallons) per flush with maximum 10 percent variance, top spud connection, wall and spud flanges and sweat solder adapter with cover tube and cast set screw wall flange. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM alloy classification for semi-red brass. Set centerline of inlet 292 mm (11 1/2 inches) above rim. Seat bumpers shall be integral part of flush valve.

- F. (P-106) Water Closet (Tank Type, pressure assisted, ANSI A112.19.2M, Figure 7) domestic, elongated bowl with tank, closed coupled, flushometer tank, floor outlet. Top of rim shall be 457 mm (18 inches) above finished floor.
1. Seat: Domestic with cover, solid molded plastic, elongated bowl. Color shall be white.
 2. Fittings: Tank fittings and accessories;
 - a. Flushing mechanism shall be: Pressure assisted, close coupled, flushometer tank, 6 L (1.6 gallons) per flush.
 - b. Stops, tank-angle.
- G. (P-107) Water Closet (Wall Hung, ASME/ANSI A112.19.2M, Figure 8) elongated bowl, 356 mm (14 inches) maximum overall width, siphon jet, wall outlet, top spud, flush valve operated 6 L (1.6 gallons per flush). Top of rim shall be 381 mm (15 inches) above finished floor.
1. Fittings and Accessories: Gaskets-neoprene; bolts with chrome plated cap nuts and washers.
 2. Flush valve: Concealed, Large chloramines resistant diaphragm, semi-red brass valve body, electric solenoid operated flush valve for remote operation by a minimum 38 mm (1 1/2 inches) diameter push button, provide 24 volt transformer, non-hold open, water saver design, 25 mm (1 inch) IPS wheel handle back check angle stop valve with vandal resistant protection cap, high pressure vacuum breaker, coupling for 38 mm (1 1/2 inches) top spud, wall and spud flanges. Provide 305 mm by 406 mm (12 inches by 16 inches) stainless steel access door with vandal proof screws as specified in Section 08 31 13, ACCESS DOORS AND FRAMES. Valve body, tailpiece and control stop shall be in conformance with ASTM alloy classification for semi-red brass.
- H. (P-110) Water Closet (Wall Hung ANSI A112.19.2M, Figure 8) elongated bowl, siphon jet 6L (1.6 gallon per) flush, wall outlet with 10 percent maximum variance, back inlet spud. Top of rim shall be 457 mm (18 inches) above finished floor.
1. Seat: Institutional/Industrial, extra heavy duty, chemical resistant, solid plastic, open front less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Seat shall be posture contoured body design. Color shall be white.
 2. Fittings and Accessories: Gaskets and bolts with chrome plated cap nuts and washers.
 3. Flush valve: Concealed, Large chloramines resistant diaphragm semi-red brass valve body, // hydraulic flush valve //, non-hold-open, push button minimum 38 mm (1 1/2 inches) diameter, 25 mm (1 inch) IPS wheel handle back check angle valve, high pressure vacuum breaker, concealed back spud connection. Valve body, tailpiece and control stop shall be in conformance with ASTM alloy classification for semi-red brass. Provide 305 mm by 406 mm (12 inches by 16-inches) stainless steel access door with vandal resistant screws as specified in Section 08 31 13, ACCESS DOORS AND FRAMES.
- I. (P-111) Water Closet (Wall Hung, ANSI A112.19.2M, Figure 8) elongated bowl, siphon jet, wall outlet, top inlet spud, with bedpan lugs 6 L (1.6 gallons) per flush with maximum 10 percent variance. Top of rim shall be 457 mm (18 inches) above finished floor.
1. Seat: Institutional/Industrial, solid plastic, extra heavy duty, chemical resistant, posture contoured body open front design less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Color shall be white.
 2. Fittings and Accessories: Gaskets-neoprene; bolts with chrome plated cap nuts and washers.
 3. Flush valve: Large chloramines resistant diaphragm, semi-red brass body, hydraulic flush valve, electric solenoid operated concealed, non-hold-open, push button operated minimum 38 mm (1 1/2 inches) diameter button, 25 mm (1 inch) IPS wheel handle back check angle stop valve, adjustable tailpiece, high pressure vacuum breaker, elbow flush connection, spud coupling for 38 mm (1 1/2 inches) top spud, and cast set screw wall and spud flanges. Provide 305 mm by 305 mm (12 inches by 12 inches) stainless steel access

door with key operated cylinder lock specified in Section 083113, ACCESS DOORS AND FRAMES.

- J. (P-112) Water Closet (Wall Hung, ANSI A112.19.2M, Figure 8) elongated bowl, siphon jet, wall outlet, back inlet spud, with bedpan lugs 6 L (1.6 gallons) per flush with maximum 10 percent variance. Top of rim shall be 457 mm (18 inches) above finished floor.
1. Seat: Institutional/Industrial, solid plastic, extra heavy duty, chemical resistant, posture contoured body open front design less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Color shall be white.
 2. Fittings and Accessories: Gaskets-neoprene; bolts with chrome plated cap nuts and washers.
 3. Flush valve: Large chloramines resistant diaphragm, electronic sensor solenoid operated flush valve, concealed, non-hold-open, with manual override button, 25 mm (1 inch) IPS wheel handle back check angle stop valve, adjustable tailpiece and vacuum breaker. Provide 330 mm by 432 mm (13 inches by 17 inches) stainless steel access door with key operated cylinder lock specified in Section 083113, ACCESS DOORS AND FRAMES. Valve body, tailpiece and control stop shall be in conformance with ASTM alloy classification for semi-red brass.
- K. (P-113) WATER CLOSET (Wall Hung with Bedpan Washer, ASME/ANSI A112.19.2M, Figure 8) electronic Sensor operated, hardwired or battery powered elongated bowl, siphon jet, wall outlet, with bedpan lugs-bedpan washer, 6 L (1.6 gallons) per flush with maximum 10 percent variance. Top of rim shall be 457 mm (18 inches) above finished floor. Provide standoff bracket support between studs for bedpan washer at height recommended by the manufacturer.
1. Seat: Institutional/Industrial, extra duty, chemical resistant, solid plastic, open front less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Seat shall be posture contoured body design. Color shall be white.
 2. Fittings and Accessories: Gaskets-neoprene, bolts with chromium plated cap nuts and washers.
 3. Flush valve: Large chloramines resistant diaphragm, semi-red brass body, electronic sensor operated battery powered or hardwired one-inch screwdriver angle check stop, override button, diverter valve assembly with spray protection cap, adjustable tailpiece, high pressure vacuum breaker, offset spud coupling for 38 mm (1 1/2 inches) top spud, spud wall support at diverter valve body, cast set screw flanges, sweat solder adapter with cover tube. Provide 24 volt transformer. Set centerline of inlet 673 mm (26 1/2 inches) above rim. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM alloy classification for semi-red brass.
- L. (P-114) Bariatric Floor Mounted Water Closet ANSI 112.19.2M, Fully enclosed floor mounted with integral seat, siphon jet, 14 gage type 304 stainless steel construction with white enviro-glaze coating and hinged seat with cover, flush valve operated, top of rim 457 mm (18 inches) above floor. Rated for bariatric use.
1. Fittings and Accessories: Gaskets-neoprene, bolts with chromium plated cap nuts and washers.
 2. Flush Valve: exposed chrome plated diaphragm type with low force ADA compliant dual flush oscillating bio-guard handle, 1.1 gallon/1.6 gallon per flush, seat bumper, integral screwdriver stop and vacuum breaker, escutcheon.
- M. (P-115) Water Closet (Floor Mounted, ASME/ANSI A112.19.2M, Figure 6) siphon jet. Top of bowl shall be 254 mm (10 inches) above finish floor.
1. Seat: Commercial weight, chemical resistant, solid plastic open front less cover for infant bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Color shall be white.
 2. Fitting and Accessories: Gaskets-neoprene, bolts with chromium plated cap nuts and washers.

3. Flush valve: Large chloramines resistant diaphragm, semi-red brass body, non-hold open ADA operating handle battery operated or hardwired exposed chrome plated, water saver design, 25 mm (1 inch) screwdriver angle check stop, adjustable tailpiece, high pressure vacuum breaker, cast set screw wall flanges and spud flanges, sweat solder adapter with cover tube, spud coupling for 38 mm (1-1/2 inch) top spud, wall and spud flanges. Set centerline inlet 292 mm (11 1/2 inches) above rim. Valve body, cover, tailpiece, and control stop shall be in conformance with ASTM alloy classification for semi-red brass.

101368 LAVATORIES

- A. Dimensions for lavatories are specified, Length by width (distance from wall) and depth.
- B. Brass components in contact with water shall contain no more than 3 percent lead content by dry weight.
- C. (P-401) Lavatory (Single Lever Handle Control ASME/ANSI A112.19.2M, Figure 16) straight back, approximately 508 mm by 457 mm (20 inches by 18 inches) and a 102 mm (4 inches) maximum apron, first quality vitreous china. Punching for faucet on 102 mm (4 inches) centers. Set with rim 864 mm (34 inches) above finished floor.
 1. Faucet: Solid cast brass construction, vandal resistant, heavy-duty single lever handle, center set. Control shall be washerless ceramic disc cartridge type. Provide laminar flow control device, adjustable hot water limit stop, and vandal proof screws.
 2. Drain: Cast or wrought brass with flat grid strainer offset tailpiece, chrome plated. Provide cover per A.D.A 4-19.4.
 3. Stops: Angle type, see paragraph 2.2 Stops. Provide cover per A.D.A 4-19.4.
 4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches) P-trap. Adjustable with connected elbow and 1.4 mm thick (17 gauge) tubing extensions to wall. Exposed metal trap surface and connection hardware shall be chrome plated with a smooth bright finish. Set trap parallel to wall. Provide cover per A.D.A 4-19.4.
- D. (P-402) Lavatory (Elbow Control, ASME/ANSI A112.19.2M, Figure 16) straight back, approximately 508 mm by 457 mm (20 inches by 18 inches) and a 102 mm (4 inches) maximum apron, first quality vitreous china. Punching for faucet on 203 mm (8 inches) centers. Set with rim 864 mm (34 inches) above finished floor.
 1. Faucet: Solid cast brass construction with washerless ceramic disc mixing cartridge type and centrally exposed rigid gooseneck spout with outlet 127-152 mm (5-6 inches) above rim. Provide laminar flow control device. One hundred millimeters (4 inches) elbow handles on faucets shall be cast, formed or drop forged copper alloy. Faucet, wall and floor escutcheons shall be either copper alloy or CRS. Exposed metal parts, including exposed part under valve handle when in open position, shall have a smooth bright finish.
 2. Drain: Cast or wrought brass with flat grid strainer and offset tailpiece, chrome plated finish.
 3. Stops: Angle type, See paragraph 2.2. Stops
 4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches) P-trap. Adjustable with connected elbow and 1.4 mm thick (17 gauge) tubing extensions to wall. Exposed metal trap surfaces and connection hardware shall be chrome plated with a smooth bright finish. Set trap parallel to wall.
 5. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- E. (P-403) Lavatory (Foot Pedal Control, ASME/ANSI A112.19.2M, Figure 16) straight back, approximately 508 mm by 457 mm (20 inches by 18 inches) and a 102 mm (4 inches) maximum apron, first quality vitreous china. Centrally located single hole in slab for rigid gooseneck spout. Escutcheons shall be either copper alloy or CRS. Provide valve plate for foot control. Set with rim 864 mm (34 inches) above finished floor.

1. Faucets: Solid cast brass construction, single rigid gooseneck spout with outlet 127 to 203 mm (5 to 8 inches) above slab. Provide laminar flow control device. Wall mounted, mechanical pedal mixing valve with self-closing pedal valve with stops, renewable seats, and supply from valve to spout, indexed lift up pedals having clearances of not more than 13 mm (1/2 inch) above the floor and not less than 356 mm (14 inches) from wall when in operation. Supply pipe from wall to valve stop shall be rigid threaded IPS copper alloy pipe. Supply pipe from valve to faucet shall be manufacturer's option. Exposed brass parts shall be chrome plated with a smooth bright finish.
 2. Drain: Cast or wrought brass with flat grid strainer and tailpiece, chrome plated finish.
 3. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches) P-trap. Adjustable with connected elbow and 1.4 mm thick (17 gauge) tubing extension nipple to wall. Exposed metal trap surface and connection hardware shall be chrome plated with a smooth bright finish.
- F. (P-404) Lavatory (Spinal Cord-Self Care, Integral with Countertop):
1. Faucet: Solid cast brass construction, chrome plated, gooseneck spout 102 by 127 mm (4 to 5 inches) above the rim, electronic sensor operated, four-inch center set mounting, wiring box 120/24 volt solenoid plug in transformer remote mounted transformer tee with check valves thermostatic mixing valve inline filter modular wiring box with transformer. Provide laminar flow control device.
 2. Valve: Type T/P combination thermostatic and pressure balancing with lever operating handle. Valve body shall be copper alloy. Internal parts shall be copper, nickel alloy, CRS or thermostatic material. Valve inlet and outlet shall be 13 mm (1/2 inch) IPS. Provide external screwdriver checkstops and temperature limit stop. Set stops for a maximum temperature of 35 degrees C (95 degrees F). Valve shall also serve P-418 in the same room, where applicable.
 3. Drain: Cast or wrought brass with flat grid strainer and offset tailpiece, chrome plated finish.
 4. Stops: Angle type. See paragraph 2.2. Stops
 5. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches) P-trap. Adjustable with connected elbow and 1.4 mm thick (17 gauge) tubing extension to wall. Exposed metal trap surface and connection hardware shall be chrome plated with a smooth bright finish. Set trap parallel to wall.
 6. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- G. (P-408) Lavatory (ASME/ANSI A112.19.2M, Figure 16) straight back, approximately 457 mm by 381 mm (18 inches by 15 inches) and a 102 mm (4 inches) maximum apron, first quality vitreous china. Punching for faucet on 102 mm (4 inches) centers. Support lavatory to wall with steel wall plate. Set with rim 864 mm (34 inches) above finished floor:
1. Faucet: Solid cast brass construction with washerless ceramic disc mixing cartridge type and centrally exposed rigid gooseneck spout with outlet 127-152 mm (5-6 inches) above rim. Provide laminar flow control device. One hundred two millimeters (4-inch) wrist blade type handles on faucets shall be cast, formed or drop forged copper alloy. Faucet, wall and floor escutcheons shall be either copper alloy or CRS. Exposed metal parts, including exposed part under valve handle when in open position, shall be chrome plated with a smooth bright finish.
 2. Drain: Cast or wrought brass with flat grid strainer and offset tailpiece, chrome plated finish.
 3. Stops: Angle type. See paragraph 2.2. Stops
 4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches)P-trap. Adjustable with connected elbow and 1.4 mm thick (17 gauge) tubing extension to wall. Exposed metal trap surface, and connection hardware shall be chrome plated with a smooth bright finish. Set trap parallel to wall.

5. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- H. (P-413) Lavatory (Counter Mounted ASME/ANSI A112.19.2M, Figure 25) vitreous china, self-rimming, approximately 483 mm (19 inches) in diameter with punching for faucet on 203 mm (8 inches) centers. Mount unit in countertop. Support countertop with ANSI A112.6.1M, Type I, chair carrier with exposed arms.
1. Faucet: Solid cast brass construction with washerless ceramic disc mixing cartridge type, rigid gooseneck spout with outlet 102 mm to 127 mm (4 inches to 5 inches) above slab with 102 mm (4 inches) wrist blade handles. Provide laminar flow control device. Faucet, wall and floor escutcheons shall be either copper alloy or CRS. Exposed metal parts shall be chrome plated with a smooth bright finish.
 2. Drain: cast or wrought brass with flat grid strainer, offset tailpiece, brass, chrome plated.
 3. Stops: Angle type. See paragraph 2.2. Stops
 4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches)P-trap, adjustable with connected elbow and 1.4mm thick (17 gauge) tubing extension to wall. Exposed metal trap surface and connection hardware shall be chrome plated with a smooth bright finish. Set trap parallel to the wall.
5. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- I. (P-414) Lavatory (Wrist Control, ASME/ANSI A112.19.2M, Figure 16) straight back, approximately 508 mm by 457 mm (20 inches by 18 inches) and a 102 mm (4 inches) minimum apron, first quality vitreous china. Punching for faucet shall be on 203 mm (8 inches) centers. Set rim 864 mm (34 inches) above finished floor.
1. Faucet: Solid cast brass construction with washerless ceramic mixing cartridge type and centrally exposed rigid gooseneck spout with outlet 102 mm to 127 mm (4 inches to 5 inches) above rim. Provide laminar flow control device. One hundred two millimeter (4-inch) wrist blade type, handles on faucets shall be cast, formed or drop forged copper alloy. Faucet, wall and floor escutcheons shall be either copper alloy or CRS. Exposed metal parts, including exposed part under valve handle when in open position, shall be chrome plated with a smooth bright finish.
 2. Drain: Cast or wrought brass with flat grid strainer, offset tailpiece, chrome plated.
 3. Stops: Angle type. See paragraph 2.2.Stops
 4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches)P-trap. Adjustable with connected elbow and 1.4 mm thick (17 gauge) tubing extension to wall. Exposed metal trap surface, and connection hardware shall be chrome plated with a smooth bright finish. Set trap parallel to the wall.
5. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- J. (P-415) Lavatory (Single Lever Handle, ASME/ANSI A112.19.2M, Figure 16) straight back, approximately 508 mm by 457 mm (20 inches by 18 inches) and a 102 mm (4 inches) minimum apron, first quality vitreous china. Punching for faucet on four-inch centers. Set rim 864 mm (34 inches) above finished floor.
1. Faucet: Solid cast brass construction, vandal resistant, heavy duty, single lever handle, center set. Control shall be washerless ceramic disc mixing cartridge type. Provide laminar flow control device, adjustable hot water limit stop, and vandal proof screws.
 2. Drain: Cast or wrought brass with flat grid strainer, offset tailpiece, brass, chrome plated.
 3. Stops: Angle type. See paragraph 2.2. Stops
 4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches)P-trap. Adjustable with connected elbow and 1.4 mm thick (17 gauge) tubing extension to wall. Exposed metal trap surface and connection hardware shall be chrome plated with a smooth bright finish. Set trap parallel to the wall. Set trap parallel to wall.
5. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- K. (P-417) Lavatory (Counter Mounted ASME/ANSI A112.19.2M, Figure 25) vitreous china, self-rimming, approximately 483 mm (19 inches) in diameter with punching for faucet on 102 mm (4

inches) centers. Mount unit in countertop. // Support countertop with ASME/ANSI A112.19.1M, Type 1, chair carrier with exposed arms //.

1. Faucet: Solid cast brass construction, Single handle deck type, 203 mm (8 inches) maximum center, gooseneck spout with outlet 127 to 178 mm (5 to 7 inches) above rim, 152 mm (6 inches) lever handle. Control shall be washerless ceramic disc mixing cartridge type. Provide laminar flow control device, high temperature limit stop and vandal proof screws.
 2. Drain: Cast or wrought brass with flat grid strainer, offset tailpiece, chrome plated.
 3. Stops: Angle type. See paragraph 2.2. Stops
 4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches)P-trap, adjustable with connected elbow and 1.4 mm thick (17 gauge) tubing extension to wall. Set trap parallel to the wall. Exposed metal trap surface and connection hardware shall be chrome plated with a smooth bright finish.
 5. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- L. (P-418) Lavatory (Sensor Control, Gooseneck Spout, ASME/ANSI A112.19.2M, Figure 16) straight back, approximately 508 mm by 457 mm (20 inches by 18 inches) and a 102 mm (4 inches) minimum apron, first quality vitreous china with punching for gooseneck spout. Set rim 864 mm (34 inches) above finished floor.
1. Faucet: Solid cast brass construction, chrome plated, gooseneck spout with outlet 102 mm to 127 mm (4 inches to 5 inches) above rim. Electronic sensor operated, 102 mm (4 inches) center set mounting, wiring box 120/24 volt solenoid plug in transformer remote mounted transformer battery operated electronic module back check valves solid brass hot-cold water mixer adjusted from top deck with barrier free design control handle and inline filter. Provide laminar flow control device. Breaking the light beam shall activate the water flow. Flow shall stop when user moves away from light beam. Provide steel access door with key operated cylinder lock. See Section 083113, ACCESS DOORS AND FRAMES All connecting wiring between transformer, solenoid valve and sensor shall be cut to length with no excess hanging or wrapped up wiring allowed.
 2. Drain: Cast or wrought brass with flat grid strainer with offset tailpiece, brass, chrome plated.
 3. Stops: Angle type. See paragraph 2.2.Stops
 4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches)P-trap. Adjustable with connected elbow and 17 gage tubing extension to wall. Exposed metal trap surface and connection hardware shall be chrome plated with a smooth bright finish. Set trap parallel to wall.
 5. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- M. (P-420) Lavatory (Sensor Control, Counter Mounted ASME/ANSI A112.19.2M, Figure 25) vitreous china, self-rimming, approximately 483 mm (19 inches) in diameter with punching for faucet on 102 mm (4 inches) centers. Mount unit in countertop. Support countertop with ASME/ANSI A112.19.1M, Type 1, chair carrier with exposed arms.
1. Faucet: Brass, chrome plated, gooseneck spout with outlet 102 mm to 127 mm (4 inches to 5 inches) above rim. Electronic sensor operated, 102 mm (4 inches) center set mounting, wiring box 120/24 volt solenoid plug in transformer remote mounted transformer batter operated electronic module back check valves solid brass hot/cold water mixer adjusted from top deck with barrier free design control handle and inline filter. Provide laminar flow control device. Breaking the light beam shall activate the water flow. Flow shall stop when user moves away from light beam. All connecting wiring between transformer, solenoid valve and sensor shall be cut to length with no excess hanging or wrapped up wiring allowed.
 2. Drain: Cast or wrought brass with flat grid strainer, offset tailpiece, chrome plated. Set trap parallel to wall.

3. Stops: Angle type. See paragraph 2.2.Stops
4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches)P-trap, adjustable with connected elbow and 1.4 mm thick (17 gauge) tubing extension to wall. Set trap parallel to the wall. Exposed metal trap surface and connection hardware shall be chrome plated with a smooth bright finish.
5. Provide cover for drain, stops and trap per A.D.A 4-19.4.

101369 HYDRANT, HOSE BIBB AND MISCELLANEOUS DEVICES

- A. (P-801) Wall Hydrant: Cast bronze non-freeze hydrant with detachable T-handle. Brass operating rod within casing of bronze pipe of sufficient length to extend through wall and place valve inside building. Brass valve with coupling and union elbow having metal-to-metal seat. Valve rod and seat washer removable through face of hydrant; 19 mm (3/4 inch) hose thread on spout; 19 mm (3/4 inch) pipe thread on inlet. Finish may be rough; exposed surfaces shall be chrome plated. Set not less than 457 mm (18 inches) nor more than 914 mm (36 inches) above grade. On porches and platforms, set approximately 762 mm (30 inches) above finished floor. Provide integral vacuum breaker which automatically drains when shut off.
- B. (P-802) Hose Bibb (Combination Faucet, Wall Mounted to // Concealed // Exposed // Supply Pipes): Cast or wrought copper alloy, combination faucet with replaceable monel seat, removable replacement unit containing all parts subject to wear, mounted on wall 914 mm (36 inches) above floor to concealed supply pipes. Provide faucet without top or bottom brace and with 19 mm (3/4 inch) hose coupling threads on spout, integral stops and vacuum breaker. Design valves with valve disc arranged to eliminate rotation on seat. Four-arm handles on faucets shall be cast, formed or drop forged copper alloy. Escutcheons shall be either forged copper alloy or CRS. Exposed metal parts, including exposed part under valve handle when in open position, shall have a bright finish.
- C. (P-804) Hose Bibb (Single Faucet, Wall Mounted to // Concealed // Exposed // Supply Pipe): Cast or wrought copper alloy, single faucet with replaceable monel seat, removable replacement unit containing all parts subject to wear, mounted on wall 914 mm (36 inches) above floor to concealed supply pipe. Provide faucet with 19 mm (3/4 inch) hose coupling thread on spout and vacuum breaker. Four-arm handle on faucet shall be cast, formed or drop forged copper alloy. Escutcheons shall be either forged copper alloy or CRS. Exposed metal parts, including exposed part under valve handle when in open position, shall have a bright finish.
- D. (P-806) Lawn Faucet: Shall be brass with detachable wheel or T-handle, straight or angle body, and be of compression type 19 mm (3/4 inch) hose threaded on spout; 19 mm (3/4 inch) pipe threaded on inlet. Finish may be rough; exposed surfaces shall be chrome plated, except handle may be painted. Set not less than 457 mm (18 inches) or more than 914 mm (36 inches) above grade. On porches and platforms, set approximately 762 mm (30 inches) above finished floor. Provide integral vacuum breaker.
- E. (P-807) Reagent Grade Water Faucet: Gooseneck, deck mounted for recirculating reagent grade water, forged brass valve body and 13 mm (1/2 inch) I.P.S. brass riser with polypropylene interior lining, polypropylene serrated hose end. Polypropylene inlet and outlet tube, compression control polypropylene diaphragm valve inside valve body. Provide inlet and outlet adapters. Color code faucets with full view plastic index buttons.
- F. (P-808) Washing Machine Supply and Drain Units: Fabricate of 16-gage steel with highly corrosion resistant epoxy finish. Unit to have 51 mm (2 inches) drain connection, 13 mm (1/2 inch) combination MPT brass sweat connection, ball type shut-off valve, 51 mm (2 inches) cast brass P-trap, duplex electric grounding receptacle and dryer outlet. Size 229 mm by 375 mm (9 inches by 14 3/4 inches) rough wall opening 203 mm by 330 mm by 92 mm (8 inches by 13 inches by 3 5/8 inches). Centerline of box shall be 1118 mm (44 inches) above finished floor.

- G. (P-809) Dialysis Box: Recessed wall // floor // box with continuously welded 18 gage CRS, Type 316, with satin finish. Wall // Floor // flange and hinged door shall be 16 gage CRS, Type 304, with satin finish. Provide polypropylene ball valve, 19 mm (3/4 inch) male supply outlet and two discharge hose brackets above 38 mm (1 1/2 inches) chemical resisting waste. Furnish each valve with flushing nipple.
- H. (P-810) Thermostatic Steam and Water Mixing Valve in Recessed Cabinet:
 1. Valve: Chrome plated bronze construction, 19 mm (3/4 inch) IPS steam inlet, 19 mm (3/4 inch) IPS water inlet, 19 mm (3/4 inch) IPS outlet, two stop and check valves with color coded heat resistant handles, unions on inlets, solid bi-metal thermostat, heat-resistant temperature adjusting handle. Provide outlet with dial thermometer (range-7 to 115 degrees C) / (range 20 to 240 degrees F), vacuum breaker and hose connection. Interior parts shall be bronze.
 2. Cabinet: Concealed cabinet for recessed installation, body 16 gage CRS, door and flange 12 gage CRS, NAAMM Number 4 finish. Piano hinge in left side of door, cylinder lock, top inlets and stainless steel hose rack. Factory assembled or a unit.
 3. Hose: Heavy duty hose, 19 mm (3/4 inch), cream color, high temperature resistance hot water or saturated steam up to 143 degrees C (290 degrees F) at 50 psi, with two high tensile cord braids and a cover of Nitrile-PVC. Provide 10668 mm (420 inches) of hose.
 4. Nozzle: Rear trigger, adjustable spray, self-closing automatic shut-off with heavy rubber cover. Internal parts of bronze, brass and stainless steel.

101370 INSTALLATION

- A. Fixture Setting: Opening between fixture and floor and wall finish shall be sealed as specified under Section 079200, JOINT SEALANTS.
- B. Supports and Fastening: Secure all fixtures, equipment and trimmings to partitions, walls and related finish surfaces. Exposed heads of bolts and nuts in finished rooms shall be hexagonal, polished chrome plated brass with rounded tops.
- C. Through Bolts: For free standing marble and metal stud partitions refer to Section 102113, TOILET COMPARTMENTS.
- D. Toggle Bolts: For hollow masonry units, finished or unfinished.
- E. Expansion Bolts: For brick or concrete or other solid masonry. Shall be 6 mm (1/4 inch) diameter bolts, and to extend at least 76 mm (3 inches) into masonry and be fitted with loose tubing or sleeves extending into masonry. Wood plugs, fiber plugs, lead or other soft metal shields are prohibited.
- F. Power Set Fasteners: May be used for concrete walls, shall be 6 mm (1/4 inch) threaded studs, and shall extend at least 32 mm (1 1/4 inches) into wall.
- G. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury.
- H. Where water closet waste pipe has to be offset due to beam interference, provide correct and additional piping necessary to eliminate relocation of water closet.
- I. Do not use aerators on lavatories and sinks.

101371 CLEANING

At completion of all work, fixtures, exposed materials and equipment shall be thoroughly cleaned.

101372 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 220800, COMMISSIONING OF PLUMBING SYSTEMS for all inspection, startup, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 220800, COMMISSIONING OF PLUMBING SYSTEMS and related sections for contractor responsibilities for system commissioning.

101373 RESTROOM FIXTURES (OWNER TO VERIFY)

Toilet:	Zurn EcoVantage 1.28 GPF wall mounted one piece elongated toilet with push button or Equal. Toilet shall have Sloan or Zurn flush valve plumbing. Shall be ADA compliant. Shall be wall mounted and ADA compliant. Shall be of porcelain construction.
Grab Bars:	Moen 18" x 1-1/4" Grab Bar or Equal. Shall be ADA compliant.
Sink:	Wall Mounted Kohler or Equal. Shall be ADA compliant. Shall be constructed of
Hand Dryer:	E88C Saniflow Hand Dryer, Push Button, Chrome plated cover, 110-120V or Equal.
Soap Dispenser:	Owner Provided.
Toilet Paper Dispenser:	Owner Provided.
Diaper Changing Table:	Koala Kare Baby Changing Station 36" L x 21" W x 4" W – Horizontal, stainless-steel with a 21" open width or Equal.

*** END OF DIVISION 10 ***

DIVISION 12A

PUMPS

GENERAL REQUIREMENTS FOR PUMPS

120101 GENERAL

The Contractor shall furnish, install, and test all pumps and drives as indicated on the Plans, or as specified herein. It is the intent of these Specifications to obtain pumps and drives of highest quality construction only, for heavy-duty continuous service or for intermittent service, whichever imposes the most severe service on the pump. Equipment of lesser quality will not be accepted. The Engineer shall be the sole judge as to the quality of the equipment that will be accepted. Pumps are not intended to necessarily be standard units. Pumps will be installed at an elevation of approximately 4,750 feet above sea level and shall be suitable for use at such altitude.

In addition to this section of the Specifications the pump shall conform to the applicable requirements of other Contract Documents including the following Divisions of the Specifications:

DIVISION 1	-	SPECIAL CONDITIONS
DIVISION 9	-	FINISHES
DIVISION 14	-	MECHANICAL EQUIPMENT
DIVISION 15	-	PIPING
DIVISION 16	-	ELECTRICAL
DIVISION 17	-	INSTRUMENTATION

Each pump shall be furnished as a complete, ready-to-install unit by a single supplier, including but not limited to pump, motor, mountings, and (if so specified and equipped) variable speed drive, and/or drive shaft assembly. All pumps for the same service shall be of one make and manufacturer and identical in all respects and characteristics. Unless otherwise noted, controls for variable speed drives shall be supplied with the pump.

Pumps that have mechanical defects or do not meet the requirements for head-capacity, horsepower, efficiency, and vibration requirements will be rejected, and shall be replaced without additional cost to the Owner for furnishing, removal, reinstallation, and retesting. Mechanical defects shall include excessive vibration, improper balancing of any rotating parts, improper tolerances, binding, excessive bearing or motor heating, defective materials, including materials that do not conform to the Specifications, improper fitting of parts, and any other defect which will in time damage the pump or unreasonably impair its efficiency or operation.

Pump friction losses, including entrance, column, shaft, and discharge losses shall be added to the total dynamic heads that are specified under each pump in order to get the head that the impeller must pump against. Pump head-capacity curves shall indicate that these losses have been included.

120110 CONSTRUCTION

Any bronze used in the manufacture of any pump shall not contain more than 2 percent aluminum nor more than 6 percent zinc.

Impellers, cases, seals, shafts, bearings, and any other item which does not comply with these Specifications as to its metallurgy, material, or hardness shall be replaced without additional cost to the Owner. Except for submerged or special service pumps, or as approved by the Engineer, pumps or adjacent piping within 3 inches of its pump flange shall be tapped at the suction and discharge for pressure gauges. Where packing gland drains are required or where water flushing or sealing of packing glands or mechanical seals is specified or shown, the Contractor shall furnish and install all necessary piping and valves. Except for submerged or special service pumps, or as approved by the Engineer, all pumps shall be provided with drip pans piped to drains.

120120 INSTALLATION

Before installation, the Contractor shall furnish five sets of installation instructions and five sets of lubrication instructions for each type of pump. These instructions shall include detailed instructions for adjustment and recommendations for the proper type of lubricant.

Pumps shall be installed and adjusted as specified and in accordance with the manufacturer's recommendations and in such manner that connecting piping will not impose any strain whatever on any pump. Pumps shall be set upon level, fully grouted foundations, so that connecting flanges, screwed connections, or flexible connections will meet without strain or distortion. Pump foundation pads shall be doweled and keyed to the floor slab upon which it rests. The pump leveling nuts shall be blocked out during grouting of foundations, the grout allowed to set for no less than three days, the leveling nuts loosened and following by grouting of the blockouts, with nonshrink grout. Any other proposed method of installation shall be submitted for the Engineer's approval prior to installation. Pumps shall be level when installed.

120128 TESTING

A certified factory test shall be made on the pump. The Contractor shall furnish to the Engineer three copies each of the test. Tests shall be made on six points of the head-capacity curve, with the points spanning the full range of TDH. The curves supplied shall show the head, capacity, efficiency, and brake horsepower. In making the tests, the total dynamic head as described in Section 120392 shall be used, and efficiencies shall be based on this description of the total dynamic head.

120130 MOTORS

Motors shall be as specified in each Section of this DIVISION 12, and as specified in Section 14-A. The rated horsepower and full-load amps shall not be exceeded at any point on the pump curve within the specified operating range of the pumps. Motor shall be equipped with 6 Platinum Winding RTD's and 2 Platinum Bearing RTD's.

120140 TESTS

In addition to the tests required by DIVISION 14, each pump and driver, unless otherwise specified, shall be field tested for compliance with these Specifications as to head-capacity and horsepower. Where specified, each pump shall be factory tested at the place of manufacture.

Factory tests shall include head-capacity, efficiency, and brake horsepower. Four copies of certified test results shall be submitted to the Engineer for approval before the pump is delivered to the jobsite. Unless otherwise specified, the Contractor shall furnish all manpower, facilities, power, and equipment required for making tests. Field and factory tests shall be conducted in accordance with the latest requirements of

the Hydraulic Institute Standards. Pumps with variable speed drives shall be tested at maximum speed, and at the average and minimum speeds listed under the specification for the pumps. A copy of actual test data shall be furnished to the Engineer.

In case factory testing of pumps provided is not specified, certified test curves for pumps of the same type as provided shall be submitted with the shop drawings.

120145 VIBRATION

Tests for acceptable vibration shall be made, at no additional cost to the Owner, in the field on each pump system, which in the opinion of the Engineer, seem to have excessive vibration. All field tests shall be running tests with the pump pumping the product for which it is intended and each pump system shall be tested separately with no other pumps running. All testing shall be done in the presence of the Engineer.

Amplitude as used in this Specification, shall mean total peak-to-peak displacement. The required test for acceptable vibration will be the measurement of this peak-to-peak displacement and will be performed with an IRD Vibration Meter, Model 306; Bently-Nevada TK-8; or equal.

No pump, complete with drive system, in place at the jobsite, shall exceed acceptable field vibration limits given in the latest revisions of the Hydraulic Institute Standards, no limits (if any) stated under the individual pump specification. All pumps shall be free of static unbalance; shall be free of dynamic unbalance up to the maximum speed of the pump and drive system; shall be free of torsional vibration from 10 percent below the minimum speed to 10 percent above the maximum speed of the pump and drive system; and shall be free of apparent unbalance caused by defective bearings, by close fittings parts which may rub on the rotating parts intermittently, or by loose discs or rotor parts, unbalanced loads, or by oil whip.

120147 WARNING SIGNS

Warning signs shall be furnished and installed as specified in Section 14-A.

120148 EQUIPMENT GUARDS

Equipment guards shall be furnished and installed as specified in Section 14-A.

120149 PAINTING

Requirements for painting of equipment shall be as specified in DIVISION 9.

120150 SHOP DRAWINGS

The Contractor shall submit for review to the Engineer, sufficient literature, detailed specifications, and drawings to show dimensions, make, style, speed, size, type, horsepower, head-capacity, efficiency, materials used, design features, internal construction, weights, and any other information required by the Engineer for review of all pumping equipment. For pumps, certified test curves shall be submitted showing this specified data. No pumping equipment will be accepted, and installation will not be allowed, until such review has been completed.

Shop drawings submitted for review also shall include electrical diagrams, schematic control diagrams, and a detailed description of how the control system is to function. Submittal information for control panels to be furnished with equipment shall be in accordance with the heading "Control Panels" below.

Additional requirements for information to be included with shop drawings are specified with the particular piece of equipment.

As specified in DIVISION 1, SPECIAL CONDITIONS, copies of each approved shop drawing shall be submitted to the Engineer, prior to completion of the Contract, for each piece of equipment or each system. This shall include all drawings, lists, schedules, etc., larger in size than 11-inch by 17-inch, for all pumping equipment.

120160 OPERATING MANUALS

The Contractor shall furnish acceptable bound operating, installation, and maintenance instructions covering each component and each assembly furnished under this Contract in accordance with DIVISION 1, SPECIAL CONDITIONS. Manuals of instruction shall be furnished prior to equipment delivery.

The operating, installation, and maintenance instructions shall include as a minimum the following data for each item furnished hereunder.

- A. Lubrication Schedule, if required.
- B. Recommended preventive maintenance procedures and schedules.
- C. Recommended spare parts.
- D. Parts lists by generic title, material of construction, and identification number (actual manufacturer's number, not supplier's).
- E. Disassembly and reassembly instructions.
- F. Recommended troubleshooting and start-up procedures.
- G. Electric schematics.
- H. List of special tools and description of use, as specified previously.

In addition, the instructions shall include prints of the installation drawings.

120161 CONTROL PANELS

Where specified for an individual system or piece of equipment, a control panel shall be furnished with the equipment. Control panels shall conform to the requirements of DIVISION 16 and as specified herein.

Control panels shall be furnished with all components within the panel rigidly mounted, all wiring within the panel brought to terminal blocks, and all control air lines within the panel bulkheaded.

Pressure gauges shall be oil-filled 4-1/2-inch diameter. Pressure transmitter shall be 2 1/2" and shall be designed for potable water and be supplied with panel-mounted units with ranges between 4-20 mA output with a 4-character LCD display. 3-16LSS Construction. The gauge housings shall be ANSI 61, light gray.

All lights, instruments, valves, pumps, and other equipment indicated on the control panels shall have an identifying label on them. These labels shall be black phenolic or lamicoic plastic with white letters and shall be fastened to the control panel with round head stainless steel screws.

Orem City shall contract separately the main control panel. Contractor responsibility shall be the mounting and coordination with Orem City's instrumentation and control controller.

*** END OF DIVISION 12A***

DIVISION 12B

LINE SHAFT PUMPS

SECTION 12-B

120300 GENERAL

Four (4) vertical turbine pumps with motors shall be furnished, installed, and tested. The pumps shall conform to all applicable requirements of AWWA E 101, Part A, and to the supplementary specifications contained herein.

The plans indicate the dimensions and design of the pump. It is the Contractor's and the pump manufacturer's responsibility to fabricate the pump to fit the physical dimensions of the pump structure and the performance of the pump shall be guaranteed for the known conditions of the pump structure and piping.

The pump shall be capable of operating against a closed discharge valve for not less than two minutes without excessive vibration, binding, rubbing of rotating parts, or damage to pump, motor, or drive.

The head-capacity curve for the pump shall be as steep as practicable within the constraints of this section, and shall exhibit a continuously rising characteristic to shutoff head, with no points of zero or slope reversal.

The pumping head shall be the total dynamic head, which in these Specifications shall be sum of the static head plus the friction head above the pump discharge outlet plus the velocity head at the discharge outlet. The pumping head does not include the losses in the entrance, column, or discharge elbow.

The rated efficiencies shall include the losses in the suction bell, in the pump column, and in the discharge elbow, and the efficiency curve plotted on the manufacturer's pump curves shall be on this basis regardless of the manufacturer's normal practice. The pumps will be field tested on this basis.

120392 OPERATING CONDITIONS

Design Point #1

Pump capacity	<u>2,050 gpm</u>
At total dynamic head	<u>260 feet</u>
Bowl efficiency at design of not less than	<u>80.0 percent</u>

Design Point #2

Pump capacity	<u>3,000 gpm</u>
At total dynamic head	<u>230 feet</u>
Bowl efficiency at design of not less than	<u>82.0 percent</u>

Design Point #3

Pump capacity	<u>3,450 gpm</u>
At total dynamic head	<u>205 feet</u>
Bowl efficiency at design of not less than	<u>78.0 percent</u>

Speed	<u>1,800 rpm</u>
Inlet water elevation range	<u>4,724.59 – 4,738.50 feet</u>
Elevation of pump can bottom	<u>4,713.00 feet</u>
Elevation of pump discharge	<u>4,749.50 feet</u>
Number of bowls	<u>4</u>

120305 MOTOR

The motor shall be a vertical hollow shaft squirrel-cage, induction type, with roller or ball bearings, rated for the pump so that the rated full-load current of the motor will not be exceeded at any point within the specified operating range of the pump. The motor shall comply with NEMA MG-1 Standards, and shall be equipped with steady bushing, space heaters, rodent guards, and nonreverse ratchet, and shall be as follows with the data shown on the nameplate.

Culinary Water Pumps

Horsepower	Not less than	<u>350</u>
Speed	At rated load	<u>1785 rpm</u>
Voltage		<u>480 v</u>
Phase		<u>3</u>
Hertz		<u>60</u>
Service factor		<u>1.15 Minimum</u>
NEMA design		<u>B</u>
Minimum insulation		<u>Class B</u>
Ambient temperature		<u>40EC</u>
Enclosure		<u>WP-1</u>
Efficiency (Minimum)		<u>95.0</u>
Power factor (Minimum)		<u>0.87</u>

A suitable base of cast iron or fabricated steel shall be provided for mounting the driver and supporting pump column. The 1.15 service factor shall be in excess of the HP rating of the motor and shall not be included as part of the HP rating of the motor. The motor shall have a cast iron frame and end brackets and space heater. The motor shall have a connection box of cast iron, split and rotatable in 90E steps. The motor shall be the proper size to drive the pump continuously over the specified operating range without exceeding its rating. The motor shall have a thrust bearing of ample capacity to carry the weight of all rotating parts plus the hydraulic thrust and shall be an integral part of the motor. The bearings shall be sized that the average life rating is not less than five years on continuous operation under maximum rated load of the motor pump assembly. The motor shall be provided with a steady bushing. The motor shall be capable of two cold and one hot start per hour without overheating the electrical components. Motor sound pressure levels shall not exceed 83 dba (mean, A-weighted) at one meter (RE. 0.0002 microbar) for free field conditions. Sound levels shall be measured in accordance with IEEE Standard No. 85 and certified test results shall be submitted to the Engineer for review.

Approved Manufacturers: NiDec, with no equal.

120310 DISCHARGE HEAD

The discharge head shall be fabricated steel (ASTM A53 Grade B pipe and ASTM A36 Steel plate) or cast iron. A flanged discharge shall be provided. Lifting lugs of sufficient strength to support the weight of the complete unit must be provided.

The baseplate and upper plate shall be as recommended by pump manufacturer to connect to anchor bolts. Windows in the outer shell shall be as small as possible but of sufficient size to permit working on the stuffing box. The stuffing box shall be a packed type provided with a collection box and drain. The drain shall be piped to the same sump through the concrete. The discharge head shall have a two-piece top shaft. The coupling and all of its component parts shall be capable of transmitting 150 percent of the shaft torque and also be capable of carrying all vertical thrusts with a liberal factor of safety. This arrangement shall permit removal of the seal and sleeve without disturbing the piping or the drive.

120320 DISCHARGE COLUMN ASSEMBLY

The column pipe shall be not less than 12-inch diameter steel pipe, (ASTM A53 Grade B) minimum 1/4 - inch wall thickness. The pipe shall be furnished in interchangeable sections not over 10 feet in length with lathe cut straight butt joint threads and machine threaded sleeve type couplings. The pump supplier shall verify that the pump assembly is designed to withstand all weights caused by the depth of the pump.

The discharge column shall be coated inside and outside with a polyamide epoxy coating in conformance with section 090143.03 EPOXY COATING. System shall be a minimum of 10 mils.

The line shafting shall be turned, ground and polished 416 stainless steel to operate the pump without distortion or vibration and shall be tested for straightness to 0.002 inches accuracy. The shafts shall be furnished in interchangeable sections not over 10 feet in length and shall be coupled with extra strong threaded stainless steel couplings machined from solid bar stainless steel. Threads shall be lathe cut and the ends of the shaft shall be machine faced. Line shaft shall not be reduced in size through the stuffing box.

The minimum line shaft shall be 2.19-inch diameter. A bearing shall be located a maximum of 5 feet from the pump and the discharge head.

The column assembly shall have bronze guides fitted into the pipe coupling and retained by the butted pipe ends. Each guide shall contain a water lubricated, cutlass rubber bearing designed for vertical turbine pump service. Bearing shall be spaced at a maximum of ten feet.

120330 BOWL ASSEMBLY

The pump bowls shall be stainless steel unless specified as other by owner, free from blow holes, sand holes and all other faults, accurately machined and fitted to close dimensions. The maximum outside diameter of the bowls shall be fitted to each well application of best design. The impeller shaft shall be of 416 stainless steel or better with one bearing on each side of every impeller. Bearings shall be either of all high lead bronze construction or a combination of high lead bronze and rubber designed for water lubrication but bearings of "rubber only" will not be acceptable. Suction case bearing shall be grease packed and fully enclosed and protected against entry of sand or abrasives. A sand collar shall be installed above the top bowl to prevent abrasive wear.

The bottom bearing housing shall be cast as an integral part of the bottom case. The housing shall have sufficient vertical depth to allow the pump shaft to move downward as the impeller face, casing, or

clearance parts wear. The bottom bearing shall be packed with a non-soluble hydraulic grease or lubricant that will not break down or dissolve and find its way into the pump stream. Such grease or lubricant shall not need replacement for the life of the pump. The bearing housing shall be provided with a cap or plug to prevent the escape of any lubricant used. The bottom bearing shall be bronze as specified for the line shaft bearing.

Impellers shall be of bronze with not more than six percent zinc content or stainless steel and shall be of the enclosed type. Enclosed impeller type bowls shall be provided with impeller seal rings or bowl wearing rings of replaceable hardened material of an alloy found to be highly resistant wear. Impellers shall be accurately fitted and dynamically balanced and shall be fastened securely to the impeller shaft in such a manner that they cannot loosen in service. Both bowls and impellers shall be designed with open end smooth water passages to secure efficient operation and to prevent air or sand locking. Sufficient lateral adjustment shall be provided in the design of the bowl assembly to permit proper impeller adjustments and to insure proper operation of the pumping unit.

120360 PUMP INSTALLATION

The Contractor shall install the pump, motor and pump starter panel according to the manufacturer's recommendations. The Contractor will finish and install leads through conduits between the pump motor and pump starter panel. Installation shall conform to the latest applicable rules and regulations of the Utah State and Local Electrical Code, the National Electrical Code, and other applicable codes. If codes conflict, the requirements of the code that is legally applicable shall be followed. Workmanship shall be of the highest grade.

120370 CHECK, TEST AND START

The Contractor shall provide the services of qualified factory authorized mechanic or mechanics as needed to check, test, and start the pumps. He shall be responsible to make certain the equipment is properly installed, aligned, wired, operating, etc. The qualifications of the mechanic shall be such that the manufacturers can certify in writing that the installation is proper and correct, and that the equipment is operating properly. A letter from the factory authorized representative shall be provided indicating the pump and motor have been installed and tested in accordance with the manufacturer's recommendations. The Contractor shall provide four (4) sets of "As-Constructed" drawings acceptable to the Engineer prior to final payment.

*** END OF SECTION 12B ***

DIVISION 12

AIR HANDLER PUMPS

SECTION 12-C

120400 GENERAL

An air handler pump shall be provided by the contractor and installed at the location shown on the plan. The plans indicate the dimension and design of the pump. It is the Contractor=s and the pump manufacturer=s responsibility to fabricate the pump to fit the physical dimensions of the pump structure and the performance of the pump shall be guaranteed for the known conditions of the pump structure and piping.

The pump shall be capable of operating against a closed discharge valve for not less than two minutes without excessive vibration, binding, rubbing of rotating parts, or damage to pump, motor, or drive.

120490 CANNED ROTOR PUMP

Pump shall be a type 316 Stainless steel, canned rotor pump for transferring raw water. Inlet and outlets shall be 3/4 or 1-inch NPT. Pump shall include stainless steel rotor can, bearing plate, and cladding. The pump housing shall be cast bronze. Mechanical seal shall include viton, stainless steel and carbon/ceramic seats.

120492 OPERATING CONDITIONS

Pump design capacity	<u>65</u> gpm
Total dynamic head	<u>25</u> feet

120493 MOTORS

The motor shall be a 2 speed, open drip proof construction, automatic reset thermal protection, three-phase 120 or 240 Volt.

Motors shall be as specified in each Section of this DIVISION 12. The rated horsepower and full-load amps shall not be exceeded at any point on the pump curve within the specified operating range of the pumps.

120494 INSTALLATION

Before installation, the Contractor shall furnish five sets of installation instructions and five sets of lubrication instructions for each type of pump. These instructions shall include detailed instructions for adjustment and recommendations for the proper type of lubricant.

Pumps shall be installed and adjusted as specified and in accordance with the manufacturer's recommendations and in such manner that connecting piping will not impose any strain whatever on any pump. Pumps shall be set upon level, fully grouted foundations, so that connecting flanges, screwed connections, or flexible connections will meet without strain or distortion. Pump foundation pads shall be doweled and keyed to the floor slab upon which it rests. The pump leveling nuts shall be blocked out during grouting of foundations, the grout allowed to set for no less than three days, the leveling nuts

loosened and following by grouting of the blockouts, with nonshrink grout. Any other proposed method of installation shall be submitted for the Engineer's approval prior to installation. Pumps shall be level when installed.

120495 PAINTING

Requirements for painting of equipment shall be as specified in DIVISION 9.

120496 SHOP DRAWINGS

The Contractor shall submit for review to the Engineer, sufficient literature, detailed specifications, and drawings to show dimensions, make, style, speed, size, type, horsepower, head-capacity, efficiency, materials used, design features, internal construction, weights, and any other information required by the Engineer for review of all pumping equipment. For pumps, certified test curves shall be submitted showing this specified data. No pumping equipment will be accepted, and installation will not be allowed, until such review has been completed.

Shop drawings submitted for review also shall include electrical diagrams, schematic control diagrams, and a detailed description of how the control system is to function. Submittal information for control panels to be furnished with equipment shall be in accordance with the heading "Control Panels" below.

Additional requirements for information to be included with shop drawings are specified with the particular piece of equipment.

As specified in DIVISION 1, SPECIAL CONDITIONS, copies of each approved shop drawing shall be submitted to the Engineer, prior to completion of the Contract, for each piece of equipment or each system. This shall include all drawings, lists, schedules, etc., larger in size than 11-inch by 17-inch, for all pumping equipment.

120497 OPERATING MANUALS

The Contractor shall furnish acceptable bound operating, installation, and maintenance instructions covering each component and each assembly furnished under this Contract in accordance with DIVISION 1, SPECIAL CONDITIONS. Manuals of instruction shall be furnished prior to equipment delivery.

The operating, installation, and maintenance instructions shall include as a minimum the following data for each item furnished hereunder.

- A. Lubrication Schedule, if required.
- B. Recommended preventive maintenance procedures and schedules.
- C. Recommended spare parts.
- D. Parts lists by generic title, material of construction, and identification number (actual manufacturer's number, not supplier's).
- E. Disassembly and reassembly instructions.
- F. Recommended troubleshooting and start-up procedures.

G. Electric schematics.

H. List of special tools and description of use, as specified previously.

In addition, the instructions shall include prints of the installation drawings.

*** END OF DIVISION 12***

DIVISION 13A

SPECIAL CONSTRUCTION

SECTION 13

CLEANING AND DISINFECTION OF STRUCTURES

130300 SCOPE

This section covers the disinfection of certain water-containing structures as specified herein.

Unless otherwise specified, disinfection work shall not be started until cleaning and leakage testing of structures has been completed. Testing of structures is covered elsewhere in this Specification.

Cleaning and disinfection of pipelines shall be as specified in the cleaning and disinfection of water lines section.

130301 GENERAL

130301.2 STATE REGULATIONS

All disinfection work shall conform to the requirements of the Utah State Department of Health, Utah State Division of Drinking Water and AWWA D105 as specified herein. If any State requirements conflict with the provision of this section, or AWWA D105, the most stringent requirements shall govern.

130301.3 DISINFECTION PLAN

Prior to starting any disinfection work, the Contractor shall submit to the Engineer a detailed disinfection plan. The plan shall cover the method and procedure proposed, necessary coordination, sequence of operations, equipment to be used, the manner of filling and flushing of each structure specified herein to be disinfected, and the neutralization and disposal of wasted water. All procedures shall be subject to acceptance by the Engineer.

130301.4 COORDINATION

The Contractor shall coordinate flushing and disinfection work with adjacent work under other phases as specified in DIVISION 1 as necessary to preclude work interference or duplication of effort and to expedite the overall progress of the work.

130301.5 EQUIPMENT AND FACILITIES

The Contractor shall provide all necessary piping connections, temporary valves, sampling taps, pumps, disinfectant, neutralization agents, chlorine residual test apparatus, and all other items of equipment or facilities required to complete the disinfection work.

130301.6 WATER

Water required for disinfection of all structures will be furnished as stipulated in the temporary facilities section.

All water used in disinfecting the structures shall be neutralized by dilution or chemical treatment prior to discharge into the drainage course storm sanitary sewer. The chlorine residual of wasted water shall not exceed 0.1 mg/l. The manner and rate of disposal of wasted water shall be acceptable to the Owner and the appropriate pollution control agency.

130301.7 CHLORINE RESIDUAL TESTS

The Contractor shall provide necessary apparatus for making chlorine residual tests by the drop dilution method in accordance with Appendix A of ANSI/AWWA C605. Tests will be made by the Owner.

130310 CLEANING

130320 STRUCTURES TO BE DISINFECTED

The following structures shall be disinfected as specified herein:

- a. Piping, fittings, valves
- b. Pumps
- c. Pump cans
- d. Culinary site piping

130330 DISINFECTION PROCEDURES

130333 POTABLE WATER MAINS

The interior of all pipe and fittings shall be kept as clean as possible at all times. If the pipe contains dirt that will not be removed by flushing, the interior of the pipe shall be cleaned and swabbed as necessary with a solution containing not less than 500 ppm of chlorine.

Prior to chlorination, all pipes 12-inch in diameter and smaller shall be flushed as thoroughly as available water sources will permit.

After cleaning as thoroughly as possible, the pipe shall be filled with as chlorine solution of sufficient strength to provide a 10 ppm chlorine residual at the end of 24 hours.

Following chlorination, the pipe shall be flushed with potable water until the chlorine residual is less than 0.6 ppm before it is put into service.

130340 DISPOSAL OF DISINFECTION WATER

All disinfection rinse water shall be dechlorinated prior to disposal. The Contractor may dispose of properly dechlorinated disinfection water by means of discharge to the storm drain. The Contractor shall obtain all permits necessary, if any, for disposal of disinfection water in this manner.

END OF SECTION 13A

DIVISION 13B

SECTION 134713 - CATHODIC PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Magnesium anodes, Type II.
2. Magnesium/manganese alloy anodes.
3. Permanent reference electrodes.
4. Wire and cable.
5. Test stations.
6. Sealing, potting, and dielectric compounds.

1.2 PERFORMANCE REQUIREMENTS

- A. Survey site and determine soil or water corrosivity (resistivity), current requirements, potential surveys, stray currents, and water chemistry/corrosivity (pH).
- B. Select anodes and accessories relevant to level of protection. Design anodes for an estimated life of 30 years before replacement.
- C. Cathodic protection systems provide protective potential that complies with referenced NACE standards. Insulators are required if needed to insulate protected metals from other structures.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For cathodic protection. Include plans, evaluations, sections, details, and attachments to other work.
 1. Detail locations of cathodic protection equipment, devices, and outlets, with characteristics and cross-references to products.
 2. Include calculations and details of anode designs.
 3. Include labeling and identifying scheme for wires, cables, and test boxes.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Basic system operation, outlining the step-by-step procedures required for system startup, operation, adjustment of current flow, and shutdown.
2. Instructions for pipe-to-reference cell and tank-to-reference cell potential measurements and frequency of monitoring.
3. Instructions for dielectric connections, interference and sacrificial-anode bonds; and precautions to ensure safe conditions during repair of pipe, tank or other metallic systems. Instructions are to be neatly bound.
4. Locations of all anodes, test stations, and insulating joints.
5. Structure-to-reference cell potentials as measured during the tests required by "Field Quality Control" Article.
6. Recommendations for maintenance testing, including instructions for pipe-to-reference cell potential measurements and frequency of testing.
7. Precautions to ensure safe conditions during repair of pipe system.

1.6 QUALITY ASSURANCE

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect anodes from exposure to rain and direct sunlight.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace permanent reference electrodes that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MAGNESIUM ANODES, TYPE II

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Corpro Companies, Inc.
2. Cott Manufacturing Company
3. CPMasters, Inc.
4. ELTECH Systems Corporation USA
5. Farwest Corrosion Control Company
6. Loresco International
7. MATCOR

- B. Comply with ASTM B843.
- C. Chemical composition as percent of weight is to be as follows:
 - 1. Aluminum: 0.010 maximum.
 - 2. Manganese: 0.50 to 1.3.
 - 3. Zinc: 0.05 maximum.
 - 4. Silicon: 0.50 maximum.
 - 5. Copper: 0.02 maximum.
 - 6. Nickel: 0.001 maximum.
 - 7. Iron: 0.03 maximum.
 - 8. Other Impurities: 0.05 each; 0.3 maximum total.
 - 9. Magnesium: Remainder.
- D. Anode Core: Galvanized steel with anode wire silver-soldered to the core. Connection is to be recessed and epoxy insulated for 600-V rating. Connection is to be covered with heat-shrinkable tubing, and insulation is to be extended over connection.
- E. Anode Wires: Factory-installed cables, with copper conductors, suitable for direct burial; not less than No. 10 AWG with Type THWN insulation in accordance with ASTM D1248 and NEMA WC 70/ICEA S-95-658; long enough to extend to accompanying junction box without splicing.
- F. Anode Backfill: Backfill materials packaged in water-permeable fabric sack or cardboard container. Anodes are to be factory installed in packaged backfill using methods that result in dense packing of fill with factory-installed anode spacers to ensure centering of anode in packaged anode backfill. Backfill material is to have the following chemical composition by weight:
 - 1. Hydrated Gypsum: 75 percent.
 - 2. Bentonite Clay: 20 percent.
 - 3. Anhydrous Sodium Sulfate: 5 percent.

2.2 MAGNESIUM/MANGANESE ALLOY ANODES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Corrpro Companies, Inc.
 - 2. Cott Manufacturing Company
 - 3. CPMasters, Inc.
 - 4. ELTECH Systems Corporation USA
 - 5. Farwest Corrosion Control Company
 - 6. Loresco International
 - 7. MATCOR
- B. Chemical composition as percent of weight is to be as follows:
 - 1. Aluminum: 0.01 maximum.

2. Manganese: 0.50 to 1.3.
 3. Copper: 0.02 maximum.
 4. Nickel: 0.001 maximum.
 5. Iron: 0.03 maximum.
 6. Other Impurities: 0.05 each; 0.3 maximum total.
 7. Magnesium: Remainder.
- C. Bare Anode Weight: 40 lb, not including core, and a nominal length of 60 inches.
- D. Anode Wires: Factory-installed cables, with copper conductors, suitable for direct burial; not less than No. 10 AWG with Type THWN insulation in accordance with ASTM D1248 and NEMA WC 70/ICEA S-95-658; long enough to extend to accompanying junction box without splicing.
- E. Anode Backfill: Backfill materials packaged in water-permeable fabric sack or cardboard container. Anodes are to be factory installed in packaged backfill using methods that result in dense packing of fill with factory-installed anode spacers to ensure centering of anode in packaged anode backfill. Backfill material is to have the following chemical composition by weight:
1. Hydrated Gypsum: 75 percent.
 2. Bentonite Clay: 20 percent.
 3. Anhydrous Sodium Sulfate: 5 percent.

2.3 PERMANENT REFERENCE ELECTRODES

- A. Copper/copper sulfate (Cu/CuSO₄), suitable for direct burial. Electrode is to be guaranteed by supplier for 30 years' service in the installed environment.

2.4 WIRE AND CABLE

- A. Anode Header Cable: Single-conductor, Type HMWPE, insulated cable specifically designed for direct-buried dc service in cathodic protection installations.
1. Conductor: Stranded, annealed, uncoated copper, not less than No. 8 AWG, complying with ASTM B3 and ASTM B8.
 2. Insulation: High-molecular-weight polyethylene, complying with NEMA WC 70/ICEA S-95-658.
 3. Minimum Average Thickness of Insulation: 110 mils for Nos. 8 through 2 AWG, and 125 mils for Nos. 1 through 4/0 AWG; rated at 600 V.
 4. Connectors: or.
- B. Conductors and Cables: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
1. Bonding Conductors for Joint and Continuity Bonds: Not less than No. 8 AWG, stranded, Type THWN copper conductors.
 2. Flexible Pipe Coupling Bonds: Flexible copper straps with electrical resistance equal to No. 1/0 AWG stranded copper wire and with five holes for five

- exothermic welds to pipe.
- 3. Test Wires: No. 12 AWG, Type THWN copper conductors.
- 4. Resistance Wires: No. 16 or No. 22 AWG nickel-chromium wire.
- 5. Cables for Installation in Conduit: Type THWN copper conductors.

2.5 TEST STATIONS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Corpro Companies, Inc.
 - 2. Cott Manufacturing Company
 - 3. CPMasters, Inc.
- B. Plastic Test Stations: Flush-mounted type, manufactured of high-impact-resistant PVC or polycarbonate with watertight conduit connections and cover and removable terminal board having at least five terminals.
- C. Test Station Mounting Enclosures:
 - 1. Non-Traffic-Area Boxes: Comply with requirements in Section 260533.16 "Boxes and Covers for Electrical Systems."

2.6 SEALING, POTTING, AND DIELECTRIC COMPOUNDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. 3M
 - 2. Chase Corporation - Chase Specialty Coatings
 - 3. Farwest Corrosion Control Company
- B. Sealing and Dielectric Insulating Compound: Comply with NACE RP0188. Black, rubber based, soft, permanently pliable, tacky, moldable, and unbacked; 0.5 inch thick.
- C. Potting Compound: Comply with NACE RP0188. Cast-epoxy, two-package type; fabricated for this purpose and covered with heat-shrinkable tape.
- D. Pressure-Sensitive, Vinyl-Plastic Electrical Tape: Comply with UL 510.

2.7 EXOTHERMIC WELDING MATERIALS

- A. Exothermic Weld Kits: Specifically designed by manufacturer for welding materials and shapes required.
- B. Exothermic Weld Caps: Dome of high-density polyethylene, 10-mil minimum thickness, filled with mastic and containing a tunnel portion to separate lead wire from exothermic

weld.

2.8 COATING REPAIR MATERIALS

- A. Touchup Coating Materials: Comply with requirements in Section 099600 "High-Performance Coatings" for coating systems for touchup of factory-applied coatings.
- B. Adhesive-Applied Coating Materials: Coating materials are to be compatible with factory-applied coating system.
 - 1. Nominal thickness of coating materials is to be not less than 20 mils, plus or minus 5 percent.
 - 2. Coating materials are to be one of the following supplied by factory-applied coating system manufacturer:
 - a. Polyvinyl-chloride, pressure-sensitive, adhesive tape.
 - b. High-density polyethylene/bituminous rubber compound tape.
 - c. Butyl rubber tape.
 - d. Coal-tar epoxy.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS, GENERAL

- A. Comply with ANSI/IEEE C2 and NFPA 70.
- B. Make connections to ferrous pipe using exothermic welding.
- C. Coat welds with the coating repair material and apply an exothermic weld cap.

3.2 INSTALLATION OF MAGNESIUM ANODES, TYPE II

- A. Install magnesium anodes at locations that clear obstructions. Install at least 36 inches and no more than 10 feet from pipe to be protected. Install in augered holes with top of anode a minimum of 36 inches below finished grade. In soils that will collapse into augered holes, use casing of galvanized sheet steel.
- B. Install anodes in a dry condition after plastic or waterproof protective covering has been completely removed from water-permeable permanent container that houses anode metal. Do not use anode-connecting wire for lowering anode into hole. Backfill annular space around anode with fine earth in 6-inch layers; compact each layer using hand tools. Do not strike anode or connecting wire during backfilling and compacting. After backfilling and compacting to within 6 inches of finished grade, pour approximately 5 gal. of water into each filled hole. After water has been absorbed by earth, complete backfilling to finished level.
- C. If rock strata are encountered before achieving specified augured hole depth, install anodes horizontally at depth at least as deep as bottom of pipe to be protected.

- D. Install anodes spaced as indicated, connected through a test station to the pipeline, allowing slack in connecting wire to compensate for movement during backfill operation.
- E. For tank protection, connect groups of anodes to collector cable. Make contact, through a test station, with tank to be protected.
- F. Do not use resistance wires to reduce current output of individual or group anodes.

3.3 INSTALLATION OF MAGNESIUM/MANGANESE ALLOY ANODES

- A. Install magnesium anodes at locations that clear obstructions. Install at least 36 inches and no more than 10 feet from pipe to be protected. Install in augered holes with top of anode a minimum of 36 inches below finished grade. In soils that will collapse into augered holes, use casing of galvanized sheet steel.
- B. Install anodes in a dry condition after plastic or waterproof protective covering has been completely removed from water-permeable permanent container that houses anode metal. Do not use anode-connecting wire for lowering anode into hole. Backfill annular space around anode with fine earth in 6-inch layers; compact each layer using hand tools. Do not strike anode or connecting wire during backfilling and compacting. After backfilling and compacting to within 6 inches of finished grade, pour approximately 5 gal. of water into each filled hole. After water has been absorbed by earth, complete backfilling to finished level.
- C. If rock strata are encountered before achieving specified augured hole depth, install anodes horizontally at depth at least as deep as bottom of pipe to be protected.
- D. Install anodes spaced as indicated, connected through a test station to the pipeline, allowing slack in connecting wire to compensate for movement during backfill operation.
- E. For tank protection, connect groups of anodes to collector cable. Make contact, through a test station, with tank to be protected.
- F. Do not use resistance wires to reduce current output of individual or group anodes.

3.4 INSTALLATION OF ZINC ANODES FOR BURIED SERVICE, TYPE Z-1

- A. Install zinc anode horizontally in a hole at least 3 inches larger than anode. Install anode under new copper water tubing, including service lines, blowoffs, and air releases. Separate piping and anode by at least 24 inches, but not more than 60 inches.
- B. Install anode midway between both ends of piping. Install anode wire in piping trench and connect to piping at an accessible location. Install anode wire in PVC conduit where rising out of the ground to the aboveground connection.

3.5 INSTALLATION OF PERMANENT REFERENCE ELECTRODES

- A. Install directly beneath the buried metallic component being protected.

3.6 INSTALLATION OF WIRE AND CABLE

- A. Install conductors, except anode wires, in PVC conduit with waterproof PVC junction boxes. Comply with requirements in Section 260533.13 "Conduit for Electrical Systems" for conduit and its installation.
- B. Anode Wire Installation: Cover trench bottom for the anode wire with 3-inch layer of sand or stone-free earth. Center wire on backfill layer and do not stretch or kink the conductor. Place backfill over wire in layers not exceeding 6 inches deep, and compact each layer. Use clean fill, free from roots, vegetable matter, and refuse. Place cable underground-line warning tape within 18 inches of finished grade, above cable and conduit.
- C. Bonding Conductors: Install conductors on metallic pipe and tanks, to and across buried flexible couplings, mechanical joints, and flanged joints except at places where insulating joints are specified. Welded and threaded joints are considered electrically continuous and do not require bonding.
 - 1. Install at least two bonds between parts requiring bonding.
 - 2. Bonding conductors must contain sufficient slack for anticipated movement between structures. Bonding conductors across pipe joints are to have not less than a 4-inch slack for pipe expansion, contraction, and soil stress.
 - 3. Connect bonding conductors to pipe, coupling follower rings and coupling middle ring or sleeve. Connect bonding conductors with exothermic welds.
- D. For wire splicing, use compression connectors or exothermic welds.

3.7 INSTALLATION OF TEST STATIONS

- A. Install test stations as follows:
 - 1. At insulating joints.
 - 2. At both ends of casings when casing material is included in the cathodic protection system.
 - 3. Where pipe crosses other metal pipes.
 - 4. Where pipe connects to existing piping system.
 - 5. Where pipe connects to dissimilar metal pipe.
- B. Install test stations on backfill complying with requirements for trench bottom fill for anode wires unless otherwise indicated.
- C. Terminate test conductors on terminal boards and install a spare set of test leads at each testing location.

3.8 INSTALLATION OF PIPE JOINTS

- A. Insulating Flange Sets: Cover flanges with sealing and dielectric compound.
- B. Insulating Unions: Install electrical isolation at each building entrance and at other locations indicated on approved Delegated Design Drawings. Cover unions with sealing and dielectric compound.

3.9 INSTALLATION OF INSULATING PIPE SLEEVES

- A. Install insulating sleeves between metallic piping and metal buildings, hangers, supports, and other metal structures. Completely surround the metallic pipe for the full length of the steel contact and effectively prevent contact between the cathodically protected metallic pipe and other metallic structures. Support insulating sleeve to prevent damage to coating and to accommodate relative movement, vibrations, and temperature differentials.

3.10 DISSIMILAR METALS

- A. Underground Dissimilar Piping: Coat insulating joint and pipe at joints of dissimilar piping material with sealing and dielectric compound for a minimum distance of 10 pipe diameters on both sides of joint.
- B. Underground Dissimilar Valves: Coat dissimilar ferrous valves and pipe with sealing and dielectric compound for a minimum distance of 10 pipe diameters on both sides of valve.
- C. Aboveground Dissimilar Pipe and Valves: If dissimilar metal pipe joints and valves are not buried and are exposed only to atmosphere, coat connection or valve, including pipe, with sealing and dielectric compound for a minimum distance of three pipe diameters on both sides of junction.

3.11 COATINGS

- A. Field Joints: Apply adhesive-applied coating system in a thickness to achieve corrosion protection equal to adjacent factory-applied coating.

3.12 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify anode wires and anode header cables with marker tape.
 - 2. Identify underground wires and cables with underground-line warning tape.
 - 3. Identify text boxes with engraved, laminated acrylic or melamine label, permanently attached to text box.

3.13 FIELD QUALITY CONTROL

- A. Comply with NACE RP0169 and NACE RP0285.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Tests and Inspections: Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Static Pull Test: Choose, at random, one completed anode of each type for this destructive test. Demonstrate that anode wire connections have enough strength to withstand a minimum tensile load of 300 lb. If test fails, replace all anodes and repeat test at another randomly selected anode.
 - 2. Insulation Testing: Before anode system is connected to pipe, test insulation at each insulating joint and fitting. Demonstrate that no metallic contact, or short circuit, exists between the two insulated sections of pipe. Replace defective joints or fittings.
 - 3. Bonding Tests: Test for electrical continuity across all bonded joints. Repair or add additional bonds until electrical continuity is achieved.
 - 4. Baseline Potentials: After backfilling of pipe and anodes is completed, but before anodes are connected to pipe, measure the static potential of pipe to soil. Record initial measurements.
 - 5. Anode Output: Measure electrical current as anodes or groups of anodes are connected to pipe. Use a low-resistance ammeter. Record current, date, time, and location of each measurement.
 - 6. Reference Electrode Potential Measurements: On completion of installation of entire cathodic protection system, make electrode potential measurements of pipe in accordance with NACE RP0169, using a copper/copper-sulfate reference electrode and a potentiometer-voltmeter, or a dc voltmeter with an internal resistance (sensitivity) of not less than 100,000 ohms per volt and a full scale of 1 or 2 V. Make measurements at same locations as those used for baseline potentials. Record voltage, date, time, and location of each measurement, using one of the following two methods:
 - a. 0.85 V Negative Voltage: With cathodic system in operation, measure a negative voltage of at least minus 0.85 V between pipe and a saturated copper/copper-sulfate reference electrode contacting the earth directly over pipe.
 - b. 100-mV Polarization Voltage: Determine polarization voltage shift by interrupting protective current and measuring polarization decay. An immediate voltage shift will occur if protective current is interrupted. Use voltage reading, after immediate shift, as base reading from which to measure polarization decay. Measure at least a minimum polarization voltage shift of 100 mV between pipe and a saturated copper/copper-sulfate reference electrode contacting the earth directly over pipe.
- E. Location of Measurements for Piping: For coated piping or conduit, measure from

reference electrode in contact with the earth directly over pipe. Measure at intervals not exceeding 400 feet. Make additional measurements at each distribution service riser, with reference electrode placed directly over service line.

- F. Interference Testing: Test interference with cathodic protection from any foreign pipes in cooperation with Owner of foreign pipes. Report results and recommendations.
- G. Stray Current Measurements: Perform at each test station. Mitigate stray currents due to lightning or overhead ac power transmission lines as provided for in NACE standards.
- H. Inspect coatings; comply with NACE RP0188. Repair imperfections of factory-applied coatings as specified in "Coatings" Article.
 - 1. Use electronic holiday detectors to detect coating imperfections.
 - 2. All damage to the protective coating during transit and handling is to be repaired before installation.
 - 3. Repair factory-applied coatings to have equal or better corrosion resistance than the factory-applied coating system. Field-repair material is to be of the type approved by, and is to be applied as recommended by, manufacturer of the coating material.

3.14 ADJUSTING

- A. Adjust cathodic current using resistors as recommended by corrosion engineer who prepared the Delegated Design Submittal in Part 1.
- B. During the first year after Substantial Completion, test, inspect, and adjust cathodic protection system every three months to ensure its continued compliance with specified requirements.

3.15 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cathodic protection system.

END OF SECTION 134713

DIVISION 14

MECHANICAL EQUIPMENT

SECTION 14-A

GENERAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

140101 GENERAL

Specifications contained in this part of the Specifications shall apply to all items of mechanical equipment the same as if these provisions were contained in the individual section of the Specifications for the equipment or any other Division herein.

Provisions specified in other parts of the Specifications apply to this Division. Applicable provisions are included in:

DIVISION 1	-	SPECIAL PROVISIONS
DIVISION 5	-	METALS
DIVISION 9	-	FINISHES
DIVISION 15	-	PIPE AND PIPING SYSTEMS
DIVISION 16	-	ELECTRICAL
DIVISION 17	-	INSTRUMENTATION

All items of equipment shall be the product of a manufacturer experienced in the design, construction, and operation of equipment for the purpose required, and who shall have established a record of successful operation of such equipment manufactured or produced by them. When two or more units of equipment for the same purpose are required, they shall be products of the same manufacturer.

Equipment shall be made up of parts which are designed to act as a unit; and the manufacturer shall guarantee that when the component parts are assembled into the final unit, these parts will fit and operate satisfactorily. The equipment manufacturer's responsibility shall extend to the selection and mounting of gear drive units, motors or other prime movers, accessories, and auxiliaries required for proper operation.

If necessary, modifications shall be made in manufacturer's standard product to make it conform to the specific requirements of the Plans and Specifications and to requirements contained in regulations issued by public agencies.

All equipment shall include all production line improvements made to the delivery or contract date.

All mechanical items shall be rated heavy-duty by the manufacturer.

Elevation of this project above sea level is approximately 4750 feet. All mechanical equipment shall conform thereto. Structural steel shall conform to ASTM A 36. Iron castings shall be tough close-grained gray iron castings in accordance with ASTM A 48.

Parts of equipment shall be amply proportioned for all stresses which may occur during operation and for any additional stresses which may occur during fabrication, transportation, handling, and erection. Bearings, unless otherwise specified, shall be designed such that at maximum loadings the AFBMA B-10 rating is not less than 40,000 hours.

The furnishing and installation of equipment shall include testing, painting, checking levels and alignment, furnishing and placing of lubricants of whatever type, and furnishing of factory-trained service mechanics or engineers where specified. All equipment when finally installed shall be complete and ready for operation without binding or overloading of critical components or motors. The Contractor shall furnish at no extra cost to the Owner all appurtenances, piping, valves, fittings, wiring, supports, hangers, and other devices as are required to place the equipment in first-class operating condition and in a neat and workmanlike manner.

Fasteners for aluminum shall be stainless steel. Steel, other than stainless steel, shall be isolated from aluminum with stainless steel, neoprene, or other approved material.

Bronze, which will be in contact with water or any liquid, used in the manufacture of any equipment, shall not contain more than 2 percent of aluminum nor more than 6 percent of zinc.

Manufacturers or suppliers of equipment furnished under this Contract shall guarantee said equipment for one year following the date of acceptance of the completed Contract by the Owner.

140105 SHOP DRAWINGS

The Contractor shall submit shop drawings on all mechanical equipment to be furnished under this Contract. The number of copies submitted shall be as specified in DIVISION 1. Prior to submitting the drawings, the Contractor shall review the information for completeness. Only complete information will be reviewed by the Engineer, and only after the Contractor has signified his approval of the information. Additional provisions on shop drawings are specified in DIVISION 1.

Shop drawings shall consist of a cover sheet, which indicates drawing number, and specifications page and number to which referenced, intended use and data summary, outline drawings, cut-away drawings, parts lists, material specification lists, and all information required to substantiate that the proposed equipment meets the Specifications. In some special cases reproducible transparencies of shop drawings shall be furnished in addition to the specified number of copies. Shop drawings submittals will not be considered complete if cut-away or assembly drawings with part and material specification lists are not included.

Shop drawings for motors shall include published dimension sheets and shall include a motor data sheet which shows all the motor characteristics, including horsepower, voltage, code letter, design letter, service factor, enclosure, and insulation. All characteristics of the motor shall be shown on the data sheet which shall have been reviewed and found acceptable by the Engineer prior to delivery of the motor.

The Contractor shall provide calculations and details on all parts individually and severally to show that the equipment offered satisfies the performance, strength, vibration, and other requirements of these Specifications.

140106 OPERATION AND MAINTENANCE MANUALS

The Contractor shall furnish four (4) copies of operation and maintenance manuals for each system or item as specified in DIVISION 1. These manuals shall be broken down into sections and indexed. The sections shall include Mechanical Equipment, Automatic and Special Valves, Control Systems, Electrical, and others as necessary. Under each section there shall be a description of the operation and maintenance, lubrication schedules, and installation instructions of each item. All sections shall be

labeled and each item shall be sub-labeled. There shall be included in the front of each booklet an index laminated with plastic on both sides for rough use. Each booklet shall be bound in clear covered 3-ring binders and delivered prior to installation of any operating equipment. No acceptance of any equipment will be made until the complete manuals have been submitted, evaluated, and found acceptable. One Contractor's copy of the complete manual shall be at the jobsite available for use by field personnel and the Engineer during installation, start-up, and testing of the equipment.

The operation and maintenance manuals shall include, as a minimum, the following data for each item of mechanical, electrical, and instrumentation equipment. Information not applicable to equipment installed in the work shall be excluded.

1. Recommended start-up and troubleshooting procedures
2. Disassembly and reassembly instructions
3. Lubrication schedule
4. Recommended preventative maintenance procedures and schedules
5. Recommended spare parts
6. Parts lists, by generic title and identification number, complete with section views of each assembly
7. Name, address, and telephone number of nearest supplier and spare parts warehouse

In addition, the O&M manuals shall contain reproducible prints of the Contract record wiring diagrams, schematics, and installation drawings required under the Electrical and Instrumentation Specifications.

140110 INSTALLATION OF EQUIPMENT

Installation of equipment shall not begin until the instructions covering that part of the equipment, as specified hereinbefore, have been supplied to the Engineer.

Equipment shall be installed complete and ready to operate. In the installation of equipment none but mechanics skilled in the various trades shall be employed.

Welding shall be by electric arc and shall be done by qualified welders in accordance with applicable welding codes.

Metal work to be embedded in concrete shall be accurately placed and held in correct position while the concrete is being placed. The surface of all metal work to be in contact with concrete shall be thoroughly cleaned immediately before concrete is placed. Anchor bolts shall be cast in place when the concrete is poured. Anchors shall be installed as recommended by the manufacturer to develop the full strength of the bolt. No use shall be made of flush shells or concrete anchors.

Anchor bolts for heavy equipment, unless otherwise detailed, shall be encased in metal tubing as indicated on the Plans. Pump and other similar foundations shall be left 1 inch below the grade of machine base unless otherwise noted on the Plans. After the proper setting of machine for alignment and

grade, the recess below the base, together with recess between the anchor bolt and the metal tube, shall be grouted and carefully finished with nonshrink grout as specified in DIVISION 3.

Moving parts of equipment and machinery shall be carefully installed, tested for operation, and adjusted so that all parts move freely and function to secure satisfactory operation.

Piping required for proper operation of equipment shall be furnished and installed. Piping layouts may require modification from that indicated on the Plans depending on equipment furnished. All costs for piping or piping modifications required to suit the particular equipment furnished shall be borne by the Contractor.

140111 ALIGNMENT OF MOTORS AND EQUIPMENT

In every case where a drive motor is connected to a driven piece of equipment by a flexible coupling, the coupling halves shall be disconnected and the alignment between the motor and the equipment checked and corrected after the complete unit has been leveled on its foundation, and again after grout has set and foundation bolts have been tightened.

In general, checking and correcting the alignment shall follow the procedures set up in the Standards of the Hydraulic Institute, Instructions for Installation, and Operation and Maintenance of Centrifugal Pumps. Equipment shall be properly leveled and brought into angular and parallel alignment.

Equipment bases shall not be grouted nor foundation bolts finally tightened until all piping connections are complete and in satisfactory alignment with no strain transmitted to the equipment.

After the seven-day test has been run successfully, the Contractor shall dowel the motor and equipment in accordance with the manufacturer's recommendations.

140118 PAINTING

Equipment shall be painted in accordance with the requirements of DIVISION 9.

140120 MOTORS

Motors shall be manufactured in accordance with NEMA Standards and shall be as specified herein unless otherwise specified in the individual equipment specifications. Not all motors are intended to be standard design motors; some motors may require special features in order to meet specified requirements.

Motors, unless otherwise specified, shall be constant-speed, squirrel-cage, induction type with roller or ball bearings in accordance with NEMA Standards and as specified in DIVISION 16; and shall be 480-volt, 3-phase, 60-Hertz for the mechanical equipment. Two-speed motors shall be dual winding.

Motors 1 horsepower and larger shall be insulated for wet area application. The winding shall be given a minimum of three (3) dips and bakes of insulating varnish and shall receive a sealer coat of epoxy or silicone. The nameplate shall read "Special Class B or F Epoxy or Silicone Insulated."

The individual Sections will generally indicate enclosure required for each application. The following shall govern in case enclosure is not specified.

Electric motors which are mounted inside and protected from the weather: horizontal motors shall be of splashproof construction with stainless steel rodent screens. Vertical motors shall be WP-1 enclosure with stainless steel rodent screens.

Electric motors which are exposed to the weather or severe moisture conditions; horizontal and vertical motors shall be totally enclosed constructed. Totally enclosed motors shall have drain holes at the lowest point in the case for condensate drainage.

The service factor for motors shall be as specified in the various Sections. If not specified, it shall be at least 1.15. The maximum applied load shall not exceed the nameplate horsepower. The amperage at maximum applied load shall not exceed the full-load nameplate amperage value.

All motors shall be rated at 40 degrees C ambient with not more than 55 degrees C rise and shall have a minimum of Class B insulation as specified before for full horsepower motors. Fractional horsepower motors shall have Class B insulation.

Single-phase motors, unless otherwise specified, shall be rated 40 degrees C ambient.

Motors shall conform to the latest ANSI, NEMA, and IEEE Standards for motors of the specified class and rating. Unless specified otherwise for a particular piece of equipment, motor bearings shall be of the anti-friction type with an AFBMA B-10 life rating of not less than 25,000 hours for integral horsepower motors and 10,000 hours for fractional horsepower motors; motor bearings shall be grease or oil lubricated with convenient provisions for inspection and servicing.

All motors except for hoisting equipment, heat pumps, unit heaters, sump pumps, and slop and lube oil transfer pumps shall be special high efficiency type. The minimum full load motor efficiency and power factor for high efficiency type motors shall be as listed hereinafter. Full load efficiency and power factor shall be shown on the nameplate.

<u>Hp</u>	<u>rpm</u>	<u>Full Load Rating, Percent</u>		<u>Hp</u>	<u>rpm</u>	<u>Full Load Rating, Percent</u>	
		<u>Eff.</u>	<u>PF</u>			<u>Eff.</u>	<u>PF</u>
1	1,800	85.5	79	30	3,600	91.7	91
	1,200	82.5	75		1,800	94.1	86
						1,200	93.6
1-1/2	3,600	84.0	91	40	3,600	92.4	90
	1,800	86.5	79		1,800	94.1	87
	1,200	86.5	75		1,200	94.1	85
2	3,600	85.5	89	50	3,600	93.0	91
	1,800	86.5	79		1,800	94.5	87
	1,200	87.5	68		1,200	94.1	86
3	3,600	85.5	89	60	3,600	93.6	90
	1,800	89.5	85		1,800	95.0	87
	1,200	88.5	74		1,200	94.5	86

5	3,600	86.5	86	75	3,600	93.6	92
	1,800	89.5	86		1,800	95.0	87
	1,200	89.5	85		1,200	94.5	86
7-1/2	3,600	88.5	88	100	3,600	93.6	90
	1,800	91.0	85		1,800	95.4	90
	1,200	90.2	85		1,200	95.0	86
10	3,600	89.5	90	125	3,600	94.1	90
	1,800	91.7	86		1,800	95.4	90
	1,200	91.7	85		1,200	95.0	90
15	3,600	90.2	88	150	3,600	94.1	90
	1,800	93.0	85		1,800	95.8	90
	1,299	91.7	85		1,200	95.4	90
20	3,600	91.0	90	200	3,600	95.0	93
	1,800	93.0	86		1,800	95.8	90
	1,200	92.4	85		1,200	95.4	87
25	3,600	91.7	90	250	3,600	94.5	93
	1,800	93.6	87		1,800	95.5	87
	1,200	93.0	85				

Motor sizes noted in the individual equipment specifications and the plans are estimates only, and it is the responsibility of the equipment manufacturers and of the Contractor to furnish motors, electrical circuits, and equipment of ample horsepower capacity to operate the equipment without exceeding the rated nameplate full-load current at rated nameplate voltage, or overheating at maximum load capacity under the most severe operating service of the equipment.

Where not shown on the Plans or in these Specifications, the manufacturer of each piece of motorized equipment shall inform the Engineer and the Contractor in writing as to the size and type of electrical controls required to properly operate the equipment. Location of conduit boxes of motors shall be shown on the manufacturer's drawings.

Motors larger than 1 horsepower shall not be aluminum construction.

140140 ELECTRICAL WORK

Unless specified otherwise in the following parts on mechanical equipment, all electrical work, materials, and equipment shall conform to the provisions under DIVISION 16, ELECTRICAL. It shall be the responsibility of the Contractor to provide complete electrical systems sized to suit the equipment furnished and installed.

140150 LUBRICATION FITTINGS

All lubrication fittings shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housing, or guards. Fittings shall be accessible from safe, permanent walk or walk areas without ladders or scaffolds. Fittings for underwater bearings shall be brought above the water surface with stainless steel tubing and mounted on edge of

structure above. Fittings shall be Lincoln "Bullneck" Hydraulic Surface Check Fittings, Lincoln Engineering Company, St. Louis, Missouri, or equivalent. Lubrication fittings shall be mounted together wherever possible. They shall not be individual fittings field-mounted together, but use shall be made of factory-mounted multiple fitting assemblies located in convenient areas. Connection from multiple fitting assemblies to point of use shall be minimum 3/16-inch stainless steel tubing, securely mounted parallel with equipment lines and protected where exposed to damage.

140160 MACHINERY AND EQUIPMENT GUARDS

Approved guards for all machinery drives, pulleys, or rotating shafting shall be detailed and furnished by the Contractor. Such guards shall be neatly and substantially constructed, adequately supported from adjacent framing, and shall be provided in all cases. While all such guards are not indicated in detail on the Plans, the Contractor is assumed to be familiar with the requirements of UOSH, and any applicable local regulations regarding machinery guards or safety devices. All guards shall be sized so that pulleys 15 percent over size may be installed. The width of the guard shall be such as to allow one additional belt to be added in the future. The frame shall be covered with expanded aluminum for heat dissipation. The Contractor shall assume the responsibility for detailing these items and submitting shop drawings to the Engineer for approval. Guards shall be constructed of 6061-T6 aluminum unless otherwise indicated. All guards shall be isolated so no dissimilar metals come in contact.

140170 TESTING

Before testing, all equipment and mechanisms shall be filled by the Contractor with the proper oil and grease as recommended by the equipment manufacturer. Contractor shall furnish all personnel, chemicals, and other necessary items as are required for the initial testing of equipment.

Each piece of equipment shall be operated by the Contractor for at least 8 hours after installation, unless the Engineer is satisfied that shorter test periods are adequate. This does not relieve the Contractor of responsibility in the event of failure, binding, overloading, overheating, or other malfunction of the equipment after initial testing is performed. Final test operation shall be as specified in DIVISION 1.

140180 SPECIAL TOOLS

All special tools that are required to assemble, disassemble, repair, and maintain any item of mechanical equipment shall be furnished with the equipment. Special tools shall include any type of tool that has been specifically made for use on an item of equipment for assembly, disassembly, repair, and maintenance. When special tools are provided, they shall be marked or tagged, and a list of such tools shall be included with the maintenance and operation instructions describing use of each marked tool.

*** END OF SECTION 14-A ***

DIVISION 14

MECHANICAL EQUIPMENT

SECTION 14-B

HVAC

140300 GENERAL

This section of these Specifications covers the work, equipment, and materials necessary for installing complete, ready for continuous use, ventilating systems as indicated on the Plans and as hereinafter specified.

The Plans shall be taken in a sense as diagrammatic. Work within this section has been indicated on the Plans approximately correct to scale, but figured dimensions and detailed drawings shall be followed in all cases. The Contractor shall check the structural Plans for detail dimensions and clearances.

Sizes of piping and ducts and their locations are indicated, but not every offset and fitting nor every structural difficulty that will be encountered during the installation of the work is indicated.

The alignment of pipes and ducts shall be varied from that indicated on the Plans, where necessary, on account of slight architectural changes or to avoid the work of any other trades, without extra expense to the Owner. The Contractor shall furnish such parts and pieces as may be necessary to install the fixtures and apparatus in accordance with the best practice of the trade and to the satisfaction of the Engineer. All work and material shall be in accordance with all codes and requirements of the District, State, and insurance and inspection authorities having jurisdiction.

Ventilation equipment and installation shall conform to applicable requirements of Section 14-A.

140310 HEATING, VENTILATION, AND AIR CONDITIONING

140311 GENERAL

The Contractor shall furnish and install all equipment and services for complete heating, ventilating, and air conditioning systems as indicated on the Plans and as specified herein.

Each item of equipment shall be furnished and installed complete with all supports, mounting frames, duct work, piping, louvers, panels, grilles, electric drive units and controls, mechanical equipment, electrical work, insulation and appurtenances ready for operation.

A collar shall be installed around gas appliance venting in attic spaces to provide a 1-inch gap between the flue and insulation.

All equipment and appurtenances shall be anchored or connected to supporting members as specified herein or as indicated on the Plans.

All mechanisms or parts shall be amply proportioned for the stresses which may occur during operation or for any other stresses which may occur during fabrication and erection. Individual parts furnished which

are alike in all units shall be alike in workmanship, design, and materials and shall be interchangeable. All equipment shall be of the manufacturer's top line, industrial-commercial grade.

The Contractor shall ascertain that all chassis, shafts, and openings are correctly located, otherwise he shall cut all new openings required at his own expense. Cutting of new openings shall be coordinated with other trades. Proposed new cutting shall be submitted to the Engineer for review and acceptance prior to cutting.

The Plans shall be taken as diagrammatic. The Contractor shall check the Structural Plans and sections for detail dimensions and clearances. Sizes of ducts and their locations are indicated, but not every offset, fitting, or structural obstruction is shown.

Alignment of ducts may be varied where necessary to account for slight architectural changes or to avoid conflict with the work of other trades without additional expense to the Owner. All supports required for the proper installation of the equipment, but not forming an integral part of the building structure, shall be provided, unless specifically noted otherwise. Equipment shall be supported on spring-type vibration isolators.

The air conditioners, coolers, heaters, and all fans, blowers, etc., furnished and installed by the Contractor shall carry the manufacturer's standard guarantee, and all such guarantees shall be forwarded to the Owner upon final acceptance of the completed systems by the Owner. All reciprocating refrigerant compressors shall carry a 5-year warranty.

The Contractor shall test and make tight all work, furnishing all equipment necessary to carry out the tests and thoroughly clean the system before starting same. The Contractor shall make sure that the system is free from all objectionable vibration and noise. Flexible connections shall be provided at connections to all mechanical equipment. All work and materials shall be in full accordance with the latest State rules and regulations or publications including those of the State Fire Marshall, the Uniform Plumbing Code, the Uniform Building Code, and all local codes. Nothing in the Plans and/or Specifications shall be construed to permit work not conforming to the above codes, rules, and regulations. Electrical work and power and motor control equipment shall be as specified in DIVISIONS 16 and 17. Electric motors shall be as specified in DIVISION 14.

140312 DUCTWORK

140312.10 GENERAL

Sheet metal ducts and plenums shall be constructed with airtight joints and seams, and shall conform to applicable codes as specified herein.

Ductwork materials shall be galvanized steel or aluminum, unless otherwise noted.

Duct gauges required are listed below:

<u>Maximum Size of Duct (inches)</u>	<u>Galvanized Steel U.S. Standard Gauge</u>
12 and less	26
13 through 30	24
31 through 54	22
55 through 84	20

Supports for horizontal ducts and plenums shall be galvanized steel angles. Supports for vertical ducts shall be band iron strap or angle bracket type.

Tape all joints on concealed ducts, except welded or soldered joints, with pressureless tape and adhesive.

Provide wood ground or metal plaster frames for fastening grilles at walls and gypsum board or plaster ceilings.

All ductwork shall be routed or installed to be free from transmitting vibration to building components. Ductwork shall not touch or come in contact with ceilings, partitions, or piping. Duct and duct supports shall not be used to support ceiling or piping.

140319 AIR HANDLER UNIT

A factory assembled air handler unit (stack fan coil style) complete with water coils, fans, motors, drain pan, and all required wiring, piping, and controls shall be furnished, installed, and tested. Units shall be tested and certified in accordance with AHRI standard 440, latest edition. All units shall have C-ETL-US listing signifying the units have been examined by ETL and are in compliance with US applicable standards. Each coil shall be factory tested for leakage at 300 psig air pressure with coil submerged in water. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation. Any costs incurred to adjust fans or coils to meet scheduled capacities shall be the sole responsibility of the contractor.

The plans indicate the dimensions and design of air handler unit. It is the Contractor's and the air handler manufacturer's responsibility to fabricate the air handler to fit the physical dimensions of the structure and to meet the designed air flow.

Provide unit mounting legs to support all sections of unit and raise unit for proper trapping. Unit mounting devices not constructed of galvanized steel shall be chemically cleaned and coated with both a rust-inhibiting primer and finished coat of rust-inhibiting enamel.

Outside panels shall be made of 18-gage galvanized steel coated with baked-on enamel finish fabricated with no exposed fasteners. The interior surfaces shall be lined with 1/2-in. thick fiberglass insulation with foil face. The unit shall have a factory-installed double deflection discharge grille and stamped supply grille. Controls shall be factory wired and mounted in a small access panel at the front of the unit.

The removal of side panels shall not affect the structural integrity of the unit. All removable panels shall be gasketed to minimize air leakage. All doors shall have gasketing around full perimeter to prevent air leakage. Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly support the unit.

Access panels and/or access doors shall be available on both sides of the unit in all sections to allow easy access to drain pan, coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance. If panels are not removable, then manufacturer shall provide access sections with doors between all internal components to ensure access and cleanability of the air handler. Access doors shall be double wall construction to prevent damage to insulation during routine maintenance. Access panels and doors shall be fully removable without the use of specialized tools to allow complete access of all interior surfaces. Door hardware shall be surface mounted to minimize penetrations in the door casing that could lead to air leakage paths.

All joints between exterior panels and structural frames, as well as joints between module frames, shall be properly sealed and gasketed to provide an air seal.

Insulation - High density, matte-faced - Interior surface of unit casing shall be acoustically and thermally lined. Insulation shall be installed with adhesive. Insulation shall have a minimum R-Value of 4 and shall be UL listed. The installation shall comply with NFPA-90A and B requirements. If edges of fiberglass insulation are exposed, the manufacturer shall be responsible for sealing exposed edges with mastic sealer to prevent erosion into the airstream.

140319.1 FANS

Centrifugal fan shall be directly driven by an electric motor. Fan wheel shall be double-width type with forward-curved blades and shall be statically and dynamically balanced. Fan wheel and scroll shall be constructed of galvanized steel. Fans shall be easily removable.

Fan shafts shall be solid, coated with a rust-inhibiting coating, and properly designed so that fan shaft does not pass through first critical speed as unit comes up to rated RPM. All fans shall be statically and dynamically tested by the manufacturer for vibration and alignment as an assembly at the operating RPM to meet design specifications. Fans controlled by variable frequency drives shall be statically and dynamically tested for vibration and alignment at speeds between 25% and 100% of design RPM. If fans are not factory-tested for vibration and alignment, the contractor shall be responsible for cost and labor associated with field balancing and certified vibration performance. Fan wheels shall be keyed to fan shafts to prevent slipping.

Fans shall be mounted on isolation bases. Internally-mounted motor shall be on the same isolation base. Fan and motor shall be internally isolated with spring isolators. Flexible canvas ducts shall be installed between fan and unit casing to ensure complete isolation. Flexible canvas ducts shall comply with NFPA 90A and UL 181 requirements. If fans and motors are not internally isolated, then the entire unit shall be externally isolated from the building, including supply and return duct work, piping, and electrical connections. External isolation shall be furnished by the contractor in order to avoid transmission of noise and vibration through the ductwork and building structure. Fan modules shall have a minimum of one access door located on the drive side of the unit to allow inspection and maintenance of the fan, motor, and drive components. Belts shall be enclosed as required by OSHA standard 29 CFR 1910 to protect worker from accidental contact with the belts and sheaves.

140319.2 MOTORS AND DRIVES

Standard fan motor shall be 3-speed, single-phase, 60 Hz permanent split capacitor type for 208, 230 or 277 volts, permanent split capacitor type, factory mounted on the blower housing. Bearings shall be permanently lubricated sleeve type. Motor shall be equipped with quick connect electrical plug. Motor shall have thermal overload protection with automatic reset.

All motors and drives shall be factory-installed and run tested. Motors shall be selected to operate continuously at 104 F (40 C) ambient without tripping of overloads. Motors shall have a +/- 10 percent voltage utilization range to protect against voltage variation. Motors shall be in compliance with EPACT when applicable. V-Belt Drive shall be constant pitch rated at 1.2 times the motor nameplate. Manufacturer shall provide for each fan a nameplate with the following information to assist air balance contractor in startup and service personnel in maintenance:

- a. Fan and motor sheave part number
- b. Fan and motor bushing part number
- c. Number of belts and belt part numbers
- d. Fan design RPM and motor HP
- e. Belt tension and deflection
- f. Center distance between shafts

Unit shall be provided with factory mounted starter.

140319.3 COILS

All coils shall have 1/2-in. copper tubes and aluminum fins with 14 fins per inch spacing; coil fins are mechanically bonded to copper tubes. The copper tubes shall comply with the ASTM B-75. The fin thickness shall be 0.0045-inches and tube thickness shall be 0.016 inches. All coils shall be tested with air at 300 psig under water. Coil shall be equipped with a manual air vent and shall be piped to supply and return risers with valves.

Supply and return connections shall be clearly labeled on outside of the unit. Standard factory-furnished and installed risers shall be up to 119 in. long with 3-in. belled ends at the top for floor to floor dimensions up to 117 in. Supply and return risers shall be 3/4-inch diameter. Risers shall be Type M or L copper insulated with 1/2-in. or 3/4-in. thick closed cell insulation. The risers shall have fixed flow valves factory installed except on the drain riser.

140319.4 DRAIN PANS

Drain pan shall be formed of 18-gage stainless steel, externally coated with a 2-part closed cell foam insulation. The drain shall be factory piped to the drain riser that shall have a removable “P-trap” allowing easy cleaning. All drain pan connections supplied by unit manufacturer including, piping, and piping connections extending from stainless steel drain pans shall be constructed of stainless steel. The contractor is responsible to ensure the unit is installed level, trapped in accordance with the manufacturer's requirements, and visually inspected to ensure proper drainage of condensate. Flat drain pans shall be acceptable in sections that may have incidental, but not continuous contact with moisture. Flat drain pans shall be accessible for cleaning.

140319.5 FILTERS

Air handler unit shall include a filter track complete with a 1-in. non-woven synthetic throwaway filter installed in the unit. Provide filter blockoff as required to prevent air bypass around filters. Filters shall be removable from one side of filter section(s). Manufacturer shall provide one set of startup filters and an additional 1 set of replacement filters.

140319.6 SCHEDULE

Location	Size	Fan Motor
BOOSTER PUMP STATION	Model: <u>Trane CSAA030 or equivalent</u> Unit Size: <u>30 TON</u> Air Flow: <u>14,000 CFM</u> Total Cooling: <u>350 MBH</u>	460 V 3 phase 6 HP (2)

140600 HVAC CONTROL SYSTEMS

140620 SYSTEM CONTROLS

The system controls shall be as follows, or equal: Carrier Debonair® 24-v digital display programmable thermostat, including factory-installed 24-v transformer, and relay board. The system shall be capable of providing automatic fan speed control based on demand or be manually set to a single speed. The system shall also be capable of controlling solenoid valves for turning on and shutting off the water supply to the system.

140630 QUALITY CONTROL

The Contractor and Manufacturer's Field Service Representative shall calibrate, adjust, and set controls for proper operation, operate systems, perform air balance adjustments, and be prepared to prove operation of new part of control system.

140700 MECHANICAL IDENTIFICATION

All mechanical equipment shall have engraved plates identifying thermostats, control panels, furnaces, air handling units, condensing units, zone dampers and other devices. Engraved plates shall include the following:

- a. Equipment mark noted on drawings (ie, CU-6)
- b. Area served.
- c. Electrical circuit No.

Engraved plates shall be Black Formica, with white reveal.

*** END OF DIVISION 14-B ***

DIVISION 14

MECHANICAL EQUIPMENT

SECTION 14-C

HOISTING EQUIPMENT

140201 GENERAL

The Contractor shall furnish and install hoisting equipment as indicated on the Plans and as specified herein. All equipment shall be provided to make a usable system for lifting and moving the various pipe, fittings, valve, and equipment.

Provisions specified in Section 14-A are applicable to this Section.

140210 SERVICE REQUIREMENTS

The equipment shall be assembled, painted, tested, and adjusted in the manufacturer's shop before shipment as far as practical. All working parts shall be arranged for convenient inspection, lubrication, adjustment, repair, or replacement. The required hoisting distance shall be as indicated on the Plans, or as specified herein, or as indicated by the Engineer. In any case, it shall be such as to allow the hoisting and removal of pipe, fittings, valve, and equipment. Lifting the vertical turbine pumps and pump cans are not required for this system.

140214 STRUCTURAL

The drawings show a suggested system for the monorail, tram, and hoist supports. The crane structural system shall be designed and provided by the hoisting equipment supplier. Alternate methods other than those shown on the Plans for supporting the equipment will be subject to approval by the Engineer.

Material such as castings, forgings, and stampings shall have a safety factor of five or more with regard to ultimate strength. Lifting cable or chain shall have a safety of factor of five or more with regard to working strength.

140230 BRIDGE CRANE

A monorail and hoist system shall be provided consisting of an I-Beam, electrically driven trolley and electric wire rope hoist. The I-beam shall be supplied by crane system supplier to fit the application and loading.

The trolley system shall be as follows:

1. The I-beam shall be provided with integral stops that limit the travel of the trolley.
2. Maximum allowable deflection of the monorail beam shall be Span divided by 600.
3. I-beam hangers shall be as indicated on the Plans. They shall be adjustable to allow accurate leveling and alignment of the I-beam to within +/- 1/8" tolerance total along its length and shall be able to adequately support the crane system from building structure.
4. The hoist capacity of the monorail shall be painted with 4" (minimum) high letters and numbers and shall be clearly visible from the operating floor.

The monorail shall have single-flanged wheels with fixed axles. All wheels shall be of forged steel, hardened to 425 Brinell, and shall be fitted with anti-friction bearings provided with seals and grease fittings or sealed for life bearings. The monorail system shall consist of the following:

2. Wall support brackets
3. Wall beams and rails
4. Monorail beam, beam end stabilizers including bracing to prevent racking or binding during operation of the trolley
5. Gear actuated on each end to move both ends of the trolley evenly without binding

140232 TROLLEY HOIST

A low headroom wire rope trolley hoist shall be provided. The hoist shall be an integrally built and supplied with an overload device.

The following hoists shall be provided:

<u>Capacity _ (Tons)</u>	<u>Mounting Height Above Floor Ft.</u>	<u>Location/Use</u>
2.0	12.5	Pump Sta./System Maintenance

Trolley Drive: Provided with adjustable torque cushioned start feature and single or dual-speed motor and direct current cushioned stop holding brakes. Tractor drive units are not acceptable.

1. Single-Flanged Wheels: Forged steel, hardened to 425 Brinell, fitted with anti-friction bearings with seals and grease fittings. Bearings shall have a B-10 life of not less than 5,000 hours.
2. Trolley Wheels: Minimum 4 inch diameter wheels with safety lugs.
3. Stops and Bumpers: Capable of absorbing energy and stopping moving trolley when at end of travel.

Hoist: HMI Duty Service Classification H3 (Standard); single speed, electric motor driven, with load brake, geared upper and lower limit switch and an overload device. Low headroom, true vertical lift.

1. Load Brake: Mechanical Weston multiple disc type running in an oil bath and automatically holding loads indefinitely and permitting lowering without acceleration under full control, and direct current operated motor brake acting directly on the motor pinion shaft the instant power is shut off. Both brakes shall be capable of sustaining a load equal to 125 percent of hoist capacity, at least 15 operations per minute, and controlled smooth inching for both directions in vertical plane.
2. Hoisting Drum: Steel or cast iron with machined grooves to depth equal to 2 rope diameter; capable of retaining at least 2 complete wraps of rope with hook in lowest position and accommodating full rope length without overlapping when hook is in highest position.
3. Hoisting Rope: Specifically designed for specified service loads; preformed, improved plow steel with fiber core; double-reeved.
4. Hoisting Block: Steel with hook supported on ball or roller bearings.
5. Hoisting Block Hook: Forged or rolled steel freely rotating on bearing support and with heavy-duty type safety latches.

Drive Speed Reducers: Oil-lubricated heat-treated steel helical gears with oiltight cases, and shafts running in anti-friction bearings.

Drive Motors: Specially designed and constructed for crane service; 460 volt, 3 phase, 3 wire, TENV squirrel-cage induction type, operating at 1,800 revolutions per minute maximum, with Class F insulation. Suitable for operation in 50 C ambient air.

Electrification:

1. Cable running from junction box to monoveyor along runway beams then to bridge; and running by tag line on bridge to hoist.
2. Control Voltage: 120 volts alternating current, supplied from a transformer on the hoist.
3. Conforming to Article 610 of the National Electrical Code.
4. Main power disconnect in enclosure.
5. Electric Power: 240 volt, 1 phase, 60 hertz.

Control:

1. Capable of controlling hoist speed, trolley travel, and bridge travel.
2. Unit Type: Pendant, momentary-contact, maintain-pressure type, automatically de-energizing, 2 speed push-button stations hanging from hoist and attached to bridge, supported by a steel cable parallel to the control cable.
3. Push Buttons: Start-stop; 2 push buttons for hoisting, 1 for each direction; 2 push buttons for trolley travel, 1 for each direction and 2 for crane travel, 1 for each direction, ON-OFF button, mainline contactor button.
4. Push-Button Labels: Directions of horizontal motions clearly marked on bridge or trolley and on control pendant.
5. Pendant Control Station and Other Electrical Control Enclosures: NEMA 4X.
6. Limit Switches: Geared to limit the up and down travel and by hook to stop hoist at highest safe point.

The hoist shall Harrington NER2M Chain Hoist with Motorized Trolley manufactured by American Equipment; or equal.

140300 TESTING

After complete installation of each system, the equipment shall be tested with a load 25 percent above the rated capacity. Load and slings shall be provided by the crane system manufacturer and removed when the tests are completed. The equipment shall be operated through a complete lift and lowering cycle to determine that the equipment will perform the functions of hoisting, and traveling, quietly, smoothly and safely. Defects in the equipment shall be corrected. Testing shall be done in the presence of the Engineer. No hoisting equipment shall be used until the load testing is concluded.

*** END OF DIVISION 14-C ***

DIVISION 15

PIPING, VALVES, GATES, AND SPECIALTIES

150000 GENERAL

Piping shall be installed as indicated on the Plans. If the Contractor desires to change any of the piping layouts shown on the Plans, they shall submit to the Engineer, for approval, their detailed proposed layouts.

Any pipe which does not meet specifications or has been rejected, shall be removed from the jobsite and disposed of by the Contractor at no extra cost to the Owner.

Where new fittings are to be cut into or attached to existing piping or where connections are to be made to existing piping, the Contractor shall furnish and install the necessary sleeves, flanges, nipples, couplings, fittings, etc. needed to accomplish the cutting-in or connections, whether specifically indicated on the Plans or not.

Lines under low head shall be laid flat or with a continuous grade so that there will be no air traps or humps in them, except at the ends where means for venting shall be provided.

In no case shall copper or copper alloy pipe or fittings carrying water or water-based solutions or slurries be attached to cast iron or steel pipe except by means of a dielectric coupling expressly made for this purpose and service.

All pipe which will operate under pressure shall be properly blocked at all fittings where the pipeline changes direction, changes size, or ends, using concrete thrust blocks in trenches and suitable anchors in structures. Concrete thrust blocks shall be sized so as to give bearing against undisturbed vertical earth banks sufficient to absorb the thrust from line pressure, allowing an earth bearing of 200 pounds per square foot per foot of depth below natural grade to a maximum of 1,000 pounds per square foot. (Earth bearing value may be increased, if substantiated by soils analysis.) The line pressure shall be the product of the nominal cross-sectional area of the pipe and the test pressures as specified for each type of pipe. The concrete shall be placed, unless specifically indicated otherwise on the Plans, so that the pipe joints and fittings will be accessible.

150010 EXPOSED PIPING

Where not detailed, exposed pipe shall be installed in straight runs parallel to the axes of the structures. Pipe runs shall be horizontal and vertical except that gravity drain lines shall be pitched down in the direction of flow not less than 1/8 inch per foot.

No exposed piping shall be erected until all equipment to which the pipe is to be attached has been installed and it can be determined where piping and fittings shall be located to make a neat efficient arrangement.

The Plans shall be taken as diagrammatic for piping that is not shown in detail. Sizes of piping and their locations are indicated, but it is not intended to show every offset and fitting nor every structural difficulty that will be encountered during the installation of the work.

The alignment of pipes shall be varied from that indicated on the Plans, without extra expense to the Owner where necessary to avoid structural or mechanical difficulties or to avoid the work of any other trades. The Contractor shall furnish such parts and pieces as may be necessary to provide a complete and operable system.

Pipework shall be suspended and supported in such manner as to prevent sagging or overstressing of pipe and connections and, furthermore, shall be supported so that no item of the piping system will transfer any load or stress to any equipment.

Air bleeder cocks shall be installed at all high points in pipe systems and pump cases and shall be of the size indicated on the Plans or minimum of 1 inch. Air bleeder cocks shall be 1- or 2-inch plug valves in accordance with these Specifications.

Piping shall be made up with a sufficient number of unions or flanged joints to permit ready breaking of lines as necessary for inspection and maintenance, in addition to such joints as are definitely shown on the Plans.

Pipe and fittings shall be assembled so there will be no distortion or springing of the pipelines. Flanges, unions, flexible couplings, and other connections shall come together at the proper orientation. The fit shall not be made by springing any piping nor shall orientation alignment be corrected by taking up on any flange bolts. Flange bolts, union halves, flexible connectors, etc. shall slip freely into place. If the proper fit is not obtained, the piping shall be altered to fit.

150011 WALL AND SLAB PENETRATIONS

No pipe shall pass through or be built into any reinforced masonry or concrete wall, floor, ceiling, roof, pilaster, column, pier, or beam, unless it is inside of a sleeve. Exceptions will be indicated on the Plans with a specific note, or specified in the Specifications, and unless so stated in words, no exception shall be considered as having been allowed in the Contract Documents. Such sleeves shall have an inside diameter not less than the outside diameter of the pipe plus 1 inch, except that for pipe smaller than 1 inch the ID of the sleeve shall be not less than twice the OD of the pipe. Such sleeves shall be placed not closer than three diameters center to center, nor shall they impair the strength of construction. The arrangement of sleeves shall be such that pipe can be pulled out of a sleeve and replaced without disturbing the structural member. Ends of sleeves shall be flush with surfaces of concrete, masonry, or plaster.

Where pipes pass through floors, walls, or ceilings of finished spaces, the end of the pipe sleeve shall be concealed with an appropriate escutcheon. Escutcheon plates shall be chrome-plated steel plates, Dearborn Brass Company, No. 1149; Keeney Manufacturing Company, No. 102 or 105; Beaton and Corbin No. 1 or 13; or equal. The space between the pipes and sleeves shall be sealed as indicated on the Plans.

Openings around any pipes through interior walls or floor of chemical rooms shall be sealed gastight with synthetic rubber caulking compound.

For all concrete pipe penetrations, contractor shall use a pipe penetration mechanical seal. Mechanical seal shall be suitable for electrical conduit, concrete, cast iron, etc. manufacturers shall be proco pen seal or equal.

150020 BURIED PIPING

All pipelines laid in open trenches shall conform to applicable parts of DIVISION 2.

Where not otherwise indicated on the Plans, all buried lines shall be laid with a minimum of a 4-foot cover without air traps or humps. Where two lines of similar service run parallel to each other, they may be laid in the same trench as close together as possible and still provide adequate room for jointing.

The laying of the pipe shall be in finished trenches free from water or debris and shall be commenced at the lowest point. Pipe shall be laid on an unyielding foundation with uniform bearing under the full length of the

barrel. If the pipe bears top or bottom markings, it shall be placed with the markings in the proper position. All adjustments to line and grade shall be made by scraping away or filling in under the pipe. If the joints are the type which require external grouting, banding, or pointing, space shall be provided under and immediately in front of the bell end of each section laid of such shape and size as to permit sufficient room for the grouting, banding, or pointing of the joints.

Before excavation is started for any run of underground piping, the Contractor shall locate and expose all existing structures, piping, conduit, etc., which intersect the line of the piping, to avoid possible damage to these during excavation operations and so that it may be determined if there will be any conflicts in location. In the event of conflicts in location or grade or both, between new piping and existing piping, the Contractor shall make adjustments in location or grade of new piping as directed by the Engineer. These adjustments, including additional fittings, shall be made at no additional cost to the Owner.

Unless otherwise shown on the Plans or specified, where pipe of any type is to be encased in concrete, the encasement shall provide a minimum of 6 inches of concrete completely around the pipe, shall fill the bottom of the trench from bank to bank, if not formed, and shall be reinforced with four continuous longitudinal reinforcing bars, one in each corner of the encasement. Concrete shall be Class C. The length of encasement shown on the Plans, or specified, shall be the minimum length, and the encasement shall end at each end at a joint in the pipe. Reinforcing bars shall be No. 4 for encasement of pipe 36 inches and smaller and No. 6 for encasement of pipe larger than 36 inches.

Where buried cast iron, ductile iron, reinforced concrete, vitrified clay, or similar rigid pipe enters a structure, it shall be by means of a coupling or wall piece cast into the wall, having a mechanical push-on, or similar flexible joint as specified or shown on the Plans at the outside face of the wall. An additional similar joint shall be installed in the line at the edge of the structure excavation where the pipe trench leaves undisturbed ground. For steel pipe a single joint may be used located not more than 2 feet from the outside face of the wall.

150030 CLEANING AND TESTING

The interior of all pipelines, above or below grade, shall be thoroughly cleaned of all adhering matter and other debris to the approval of the Engineer. No testing of any pipeline shall be started until the cleaning is complete and approved.

Special precautions required in the cleaning of a particular pipeline shall be as stated in the various parts of this Division of these Specifications.

All pipelines, above or below grade, shall be tested to the pressures indicated in the various parts of this Division of these Specifications. Any piping for which test pressure is not specified shall be tested under a pressure of 25 psi above the operating head or as directed by the Engineer.

Pipe underground may be tested before backfilling unless otherwise specified, and pipes to be encased in concrete or under concrete slabs shall be tested before the encasement or slabs are poured.

The Contractor shall furnish all necessary personnel, supplies, equipment, bulkheads, and whatever additional equipment is required to make any and all tests specified and shall make any and all repairs, including relaying if necessary, to any and all pipelines failing to pass the testing requirements of these Specifications.

The Contractor shall give the Engineer a list of the scheduled pipeline tests by noon of the day preceding the scheduled test or tests. The Contractor shall notify the Engineer by written memorandum of his readiness (not just his intention) to test a line or portion of line. All bulkheads, thrust blocks, anchors, temporary connections, pumps, etc. shall be in place before the Contractor's notification of readiness is given to the Engineer. After testing, all pipes shall be flushed or blown out and left clean.

In testing with water, the test pressure specified shall be the pressure at the lowest point in the piping concerned. In testing with water, the lines shall be examined and any visible leaks repaired. In testing with air, the lines shall be examined and tested with soap suds and any leaks repaired. Testing shall be repeated until the lines are in satisfactory condition.

Despite any previous testing, any leaks developing before the end of the one year guarantee period shall be repaired by the Contractor at no additional expense to the Owner.

150031 SPECIAL PIPING TESTS

Plumbing piping, natural gas piping, and bottled gas piping shall be tested in accordance with local and State Codes and Underwriters' requirements.

150032 GAS AND AIR PIPING TESTS

All gas air lines shall be tested with air at the pressure specified under PIPING TEST SCHEDULE.

150036 POTABLE WATER LINES

Water pipelines shall be disinfected, prior to being placed in service, by filling the pipeline with a chlorine solution, expelling all air from the pipeline, and retaining the solution in the pipeline for 24hours. The strength of the chlorine solution shall be such that at the end of the 24 hour period the solution shall contain a chlorine residual of not less than 10 ppm at all points in the pipeline. Disinfection of the pipelines shall conform to AWWA C 651-05 except as modified herein. All details of the procedure shall be subject to the approval of the Engineer.

The effectiveness of the disinfection of the water lines shall be demonstrated by laboratory examination of samples in accordance with AWWA C 651-05. Should the initial treatment fail to result in a disinfected system, the Contractor shall repeat chlorination of the system until satisfactory results are obtained, all at no additional cost to the Owner. The Owner will furnish the water required for the initial disinfection, if additional disinfection is required then the Contractor shall pay for such additional water.

All materials included in the installation of potable waterlines, including pipes, gaskets, lubricants and o-rings, shall meet the requirements of NSF Standard 61, Drinking Water Systems Components - Health Effects.

150060 PIPING SCHEDULE

Where not specifically noted on the Plans or otherwise specified, pipe shall be installed in accordance with the following schedule.

Pipe listed as "aboveground" shall include that within buildings, tunnels, or other structures without regard to its elevation. "Underground" piping shall be taken to mean only that piping actually buried in the soil or cast in concrete masonry. "Underwater" piping shall mean piping which extends below tops of walls or concrete deck into basins or concrete tanks containing water.

The Contractor may, at his expense, furnish piping of the same material as shown in the PIPING SCHEDULE but of greater pressure rating than that specified. Where bell and spigot joints are shown on the Plans or specified, mechanical joints or push-on joints may be used.

The Contractor is responsible for furnishing and installing all necessary piping to make all equipment and other parts of the plant functional. Should the type of pipe for a given use be not shown, the following paragraphs

shall serve as a guide with the approval of the Engineer in the selection of the proper pipe to use for a given service. Water piping less than 4 inches in size may be galvanized steel pipe (aboveground), rigid plastic pipe (underground), or copper pipe. Water pipe between 4 inches and 12 inches in size may be cement lined ductile iron pipe.

<u>Legend</u>	<u>Use</u>	<u>Piping</u>	<u>Joints/Fittings</u>	<u>Test Pressure</u>
PSP	Pump Station Piping	Ductile Iron Class 51 or Sched. 40 AWWA C200 Welded Steel. Pump cans shall be Sched. 80 AWWA C200 Welded Steel unless specified otherwise by owner.	150# Flanged or Mechanical Joint	150 psi
CWSP	Culinary Water Site Piping (Buried)	Ductile Iron Class 51 or C-900 PVC DR-18	150# Flanged or Mechanical Joint	150 psi
SWSP	Secondary Water Site Piping (Buried)	HDPE SDR-9 or C-900 PVC DR-18	Compression/ Mechanical Joint	150 psi
SS	Sanitary Sewer (Gravity)	SDR-35 PVC	Rubber Gasket Bell & Spigot	4psi (air test)
DP	Pump Station Drain Piping	ABS, PVC, or Cast Iron	Bell & Spigot/ Solvent weld/ Mechanical Joint	20 feet*
PW	Air Vent, Sample Tap	Type "K" Copper, Brass, or PVC SCH 40	Soldered / NPT/ Solvent Weld	150 psi
G	Gas	Black Steel, ASTM A 106, Grade A; Polyethylene (yellow gas pipe)	NPT	50 psi
D	Stormdrain Piping	RCP Class III or Duel walled PE	Rubber Gasket Bell & Spigot	N/A
AC	Air Handler	HDPE SDR-9 or PVC Schd. 40	Compression/ Solvent weld	150 psi

* feet of water gauge

All valves installed in a given line shall be designed to withstand the test pressure as listed above for that particular line and shall be fabricated with ends to fit the piping.

150070 CONNECTION TO IN-SERVICE LINES

Existing pipe to which connections are to be made shall be exposed by the Contractor as directed by the Engineer, to permit field changes in line, grade, or fittings, if necessary.

All connections to existing lines shall be constructed according to the Plans and Specifications.

When shutdown of an in-service line is necessary in order to connect to the new lines, a conference between the Contractor's representative, the Engineer, and operating supervisory personnel shall establish the time and procedures to ensure that the shutdown will be for the shortest possible time. If necessary, shutdowns may be scheduled during other than normal working hours, at no additional cost to the Owner.

150100 CAST IRON AND DUCTILE IRON PIPE

Cast iron pipe specified or indicated in the Contract Documents shall be substituted with ductile iron pipe.

Ductile iron pipe shall conform to the requirements of ANSI A 21.50 and ANSI A 21.51 (AWWA C 150 and AWWA C 151). Ductile iron pipe fitted with threaded flanges shall conform to ANSI 21.15 (AWWA C 115).

Unless shown otherwise on the Plans, the minimum acceptable rating shall be Class 51.

150101 GROOVED-END DUCTILE IRON PIPE - GENERAL

Grooved-end pipe with mechanical pipe couplings (victaulic type) and fittings may be installed in place of flanged systems at aboveground locations and in approved services on this project. Grooved-end pipe shall not be used for systems which may be steamed.

Pipe and fittings shall be cut with a radius groove. Method of grooving shall be in accordance with mechanical pipe coupling manufacturer's specifications. Pipe to be grooved shall have wall thicknesses not less than the minimum recommended by the coupling manufacturer for cut-grooving. Connections to valves and flanged-end pipe shall be by grooved-end to flanged pipe adapter flange or flanged adapter nipple. Grooved pipe and fitting ends shall be lightly coated with lubricant approved by the coupling manufacturer prior to placing gasket. Pipe sizes 4-inch through 18-inch nominal diameter shall be Class 54, minimum; pipe sizes 20-inch nominal diameter shall be Class 55, minimum; pipe sizes 24-inch in nominal diameter shall be Class 56, minimum. Grooved-end pipe shall be supported in accordance with manufacturer's recommendations. In addition, at least one support shall be used between any two couplings.

The Contractor shall submit a listing of services and locations where he proposes to use grooved-end pipe prior to start of installation of any grooved-end piping. This listing shall be subject to the Engineer's acceptance, and acceptance in writing by the Engineer will be required prior to the delivery of any grooved piping materials to the site of the Work.

The Contractor shall submit for review complete information showing fittings, gaskets, mechanical pipe couplings, grooving of pipe and pipe lining or coating prior to installation of any pipe. All materials proposed for use are subject to Engineer's acceptance.

Mechanical pipe couplings and grooved-end pipe shall be installed in accordance with the coupling manufacturer's representative's recommendations.

150102 GROOVED-END DUCTILE IRON PIPE COUPLINGS AND FITTINGS

Grooved-end ductile iron pipe shall be joined by mechanical pipe couplings. Mechanical couplings shall be self-centering and shall engage and lock in place the grooved pipe and pipe fitting ends in a positive watertight couple. Couplings shall be fabricated in two or more parts of malleable iron in accordance with ASTM A 47, Grade 32510. Couplings shall be the flexible grooved type for radius grooved pipe.

Coupling assembly shall be securely held together by two or more steel bolts and nuts of heat-treated carbon steel. Nuts and bolts shall be in accordance with ASTM A 183 and ASTM A 194, Grade 2.

Couplings shall hold in place a composition water-sealing gasket designed so that internal water pressure serves to increase the seal's water tightness. Sealing gaskets shall be chlorinated butyl in accordance with ASTM D 2000, Grade No. 3BA615A14B13 with special heat-resistance test of 16 hours at 350 degrees F and maximum elongation change of minus 30 percent.

All pipe fittings used in connection with mechanical pipe couplings shall be radius grooved for grooved-end ductile iron pipe. Radius grooved cast iron fittings shall conform to the requirements of ANSI B 16.1. The outside surface of pipe between the groove and pipe end must be smooth and free from deep pits or swells and shall provide a leak tight surface for the gasket.

150110 JOINTS

Where so indicated or specified, joints shall be made with flexible couplings or with mechanical couplings for grooved or shouldered end pipe. Unless otherwise noted, joints that are not buried in the ground shall be flanged joints. All other joints shall be mechanical joints, or push-on joints. Mechanical joint, or push-on joint pipelines shall have flanges where necessary for valves and clean out connections.

150111 FLANGED JOINTS

Flanges may be cast integrally with the pipe, in which case they shall conform to ANSI B 16.1 as to diameter, thickness, drilling, and other characteristics, or they may be screwed on the threaded ends of the pipe. Screwed-on flanges shall conform to ANSI B 16.1 as to material, diameter, thickness, drilling, and other characteristics, but shall have long hubs threaded specially for ductile iron pipe. Pipe shall be Class 53, minimum. Screwed-on flanges shall be attached to the pipe by the pipe manufacturer, and after attachment the faces of the flanges and the ends of the pipe shall be refaced so that the end of the pipe will be even with the face of the flange and both will be perpendicular to the axis of the pipe. Bolt holes on the two flanges on a piece of pipe shall be in perfect alignment. Bolts shall be zinc plated or galvanized conform to ANSI B 16.1 except that flanges underground, in concrete pipe valve boxes, or in water shall have cast iron bolts and nuts, Type 304 or Type 316 stainless steel, or Everdur bolts and nuts.

Cast iron bolts and nuts shall be made of material having at least 50,000 psi tensile strength. The cast iron bolts used with mechanical joints will be acceptable.

Where cap screws or stud bolts are required, flanges shall be provided with tapped holes for such cap screws or stud bolts.

Gaskets shall be ring gaskets suitable for the intended application, manufactured by Garlock, Cranite, or equal.

All flange bolts shall be cut and finished to project not more than 1/4 inch beyond outside face of nut after joint is assembled.

150112 MECHANICAL JOINTS

Mechanical joints shall be in accordance with ANSI A 21.11 (AWWA C 111). Bolts shall be Core-10 T-bolts or equal.

150113 PUSH-ON JOINTS

Push-on rubber gasket joints shall be in accordance with ANSI A 21.11 (AWWA C 111).

Any product which is used to coat, seal, patch or otherwise attach itself to the interior surface of any piping material in such a way as to come into contact with the drinking water, shall comply with National Sanitation Foundation (NSF) Standard 61. Pipes bearing appropriate markings indicating NSF approval and lubricant containers with NSF labels will provide sufficient evidence of compliance with this requirement.

150115 RESTRAINED PUSH-ON JOINTS

Restrained push-on joints shall be designed for working pressures of 350 psi for sizes 4-inch through 24-inch and 250 psi for sizes 30-inch through 54-inch. The restraining system shall be comprised of ductile iron locking segments inserted through slots in the bell face and providing positive axial lock between the bell interior surface and a retainer weldment on the spigot end of the pipe. An alternate system shall have positive restraint against joint separation by a retainer weldment through a boltless system.

150120 FITTINGS

Except as otherwise provided, fittings for cast iron or ductile iron pipe shall be as specified in ANSI A 21.10 (AWWA 110), of the same pressure rating and same joint configuration as the pipe with which they are used.

150121 PUSH-ON

Push-on rubber gasket joint fittings shall have bodies as specified above with bells dimensioned and arranged to match the push-on joints on the pipe. Mechanical joint fittings may be used with push-on rubber gasketed joint pipe.

150122 FLEXIBLE FITTINGS

Flexible fittings applicable to cast iron pipe shall be as specified under the PIPING SPECIALTIES section of these Specifications.

150130 LINING AND COATING

Except as otherwise specified, all cast iron and ductile iron pipe and fittings shall be smooth cement-lined in accordance with ANSI A 21.4 (AWWA C 104). Special attention shall be given to the lining of fittings. Lining shall be applied to bare metal. All lining shall extend to the faces of flanges, to the end of spigots, or to the shoulder of hubs, as the case may be.

In addition, all cast iron and ductile iron pipe and fittings shall be coated inside and outside with bituminous material except that pipe which is to be painted shall not be coated on the outside.

Pipe used in sewage or sludge piping systems shall not be cement-lined.

150140 HANDLING OF PIPE AND FITTINGS

Pipe and fittings shall be carefully handled during loading, unloading, and installation. No pipe shall be dropped from cars or trucks to the ground. All pipe shall be carefully lowered to the ground by mechanical means. In shipping, pipe and fittings shall be blocked in such manner as to prevent damage to castings or cement lining. Any broken or chipped lining shall be carefully patched to the satisfaction of the Engineer. Where it is impossible to repair broken or damaged lining in pipe because of its size, the pipe shall be rejected as unfit for use unless facilities are provided for relining pipe in accordance with these Specifications. Pipe shall not be dropped or pounded to fit grade.

All mechanical joint or bell and spigot pipe shall be laid with 1/8-inch space between the spigot and shoulder of the pocket.

150160 CORROSION PROTECTION

Ductile iron pipe underground shall be protected against external corrosion by loose polyethylene sleeves in accordance with AWWA C 105. Optional method "A" per C105 shall be used as follows:

- A. Cut a section of polyethylene tube approximately two feet longer than the pipe section. Remove all lumps of clay, mud, cinders, or other material that might have accumulated on the pipe surface during storage. Slip the polyethylene tube around the pipe, starting at the spigot end. Bunch the tube accordion-fashion on the end of the pipe. Pull back the overhanging end of the tube until it clears the pipe end.
- B. Dig a shallow bell hole in the trench bottom at the joint location to facilitate installation of the polyethylene tube. Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe.
- C. Move the cable to the bell end of the pipe and lift the pipe slightly to provide enough clearance to easily slide the tube. Spread the tube over the entire barrel of the pipe. *Note: Make sure that no dirt or other bedding material becomes trapped between the wrap and the pipe.*
- D. Make the overlap of the polyethylene tube by pulling back the bunched polyethylene from the preceding length of pipe and securing it in place using tape, plastic tie straps, or any other material capable of holding the polyethylene encasement snugly against the pipe.
- E. Overlap the secured tube end with the tube end of the new pipe section. Secure the new tube end in place.
- F. Take up slack in the tube along the barrel of the pipe to make a snug, but not tight, fit. Fold excess polyethylene back over the top of the pipe.
- G. Secure the fold at several locations along the pipe barrel (approximately every three feet).
- H. Repair all small rips, tears, or other tube damage with adhesive tape. If the polyethylene is badly damaged, repair the damaged area with a sheet of polyethylene and seal the edges of the repair with adhesive tape.
- I. Carefully backfill the pipe according to the AWWA C600 standard for backfill procedure. To prevent damage during backfilling, allow adequate slack in the tube at the joint. Backfill should be free of cinders, rocks, boulders, nails, sticks, or other materials that might damage the polyethylene. Avoid damaging the polyethylene when using tamping devices.

150170 TESTING

All pipelines for which testing is not otherwise specified shall be tested for watertightness by subjecting each section to Hydrostatic Pressure and Leakage Tests in accordance with applicable provisions of AWWA C 600, except as modified below. The Contractor shall provide all vents, piping, plugs, bulkheads, valves, bracing, blocking, pump, measuring device, and all other equipment necessary for making the tests. The Owner will furnish the water required for the first test, if more than one test is required then the Contractor shall pay for the water required to make the additional tests. Each section of a new line between sectionalizing valves or between the last sectionalizing valve and the end of the project shall be tested separately as required in AWWA C 600, and/or as modified in these Specifications, except that any such section less than 500 feet in length may be tested with the adjacent section, if both sections of line have the same pipe class rating. No section greater than ½-mile in total pipe length shall be tested without special written permission of the Engineer. The duration of each test shall be at least 2 hours.

If two or more sections are tested together, the total leakage shall not exceed that allowable for the shortest section.

150171 PRESSURE TEST

All pipelines shall be tested by subjecting each section to a pressure, measured at the lowest end of the section, of at least 125 percent of the class rating or design pressure of pipe under test.

The test may be made before or after backfilling. However, if mechanical compaction is to be used in the backfilling operations as spelled out in AWWA C 600, the test shall not be made until the backfilling is completed and compacted. All connections, blowoffs, hydrants, and valves shall be tested with the main as far as is practicable.

The test section shall be slowly filled with potable water, and all air shall be vented from the line. The rate of filling shall be as determined by the Engineer, with at least 24-hour notice required before tests are scheduled. While the test section is under test pressure, a visual inspection for leaks shall be made along the pipeline, and all visible leaks repaired. The pressure test shall not begin until the pipe has been filled with water for at least 24 hours to allow for absorption.

150172 LEAKAGE TEST

Leakage test shall be made after pressure test has been satisfactorily completed and all backfilling and compaction is completed to top of trench. The Contractor shall furnish the necessary apparatus, and assistance to conduct the test.

To pass the leakage test, the leakage from the pipeline shall not exceed the leakage allowed by AWWA C600 Section 4 Hydrostatic Testing. A copy of this test is in the Appendix.

Should the test on any section of the pipeline show leakage greater than specified above, the Contractor shall locate and repair the defective pipe, fittings, or joint until the leakage is within the specified allowance of two-hour duration. All repairs and retests, if required, shall be made without additional cost to the Owner.

Connections to the existing pipelines or existing valves shall not be made until after that section of the new construction has satisfactorily passed the hydrostatic tests.

150200 STEEL PIPE

Except as otherwise specified or indicated on the Plans, steel pipe and fittings shall be as follows.

Steel pipe 12 inches and smaller in nominal diameter shall be seamless or straight seam electric resistance welded pipe conforming to the requirements of ASTM A 53 or ASTM A 120.

Steel pipe over 12 inches in nominal diameter shall be in accordance with AWWA C 200, except that butt strap, riveted, or swaged joints may not be used. Pipe over 12 inches in diameter shall have a wall thickness of not less than 1/4-inch to 72-inch diameter and 5/16-inch over 72-inch diameter, unless indicated otherwise on the Plans. All pipe shall be black unless indicated otherwise on the Plans or specified to be galvanized. If galvanized, it shall be galvanized in accordance with ASTM A 120. The working stress for any of the steels specified as acceptable for fabrication of pipe shall not exceed 50 percent of the yield point of the steel used.

Wherever Dresser or Victaulic couplings are to be used on pipe 24 inches in diameter, or over, having a wall thickness of less than 1/2 inch, stub ends not less than 6 inches long and 1/2 inch in thickness shall be provided for insertion into the couplings.

Steel pipe for liquid or gaseous dry chlorine shall be ASTM A 106, Grade A, Schedule 80, assembled with 300 psi malleable iron fittings and ammonia type flanges.

Steel pipe and fittings shall be designed in accordance with AWWA Manual M11.

150201 GROOVED-END STEEL PIPE - GENERAL

Grooved-end pipe with mechanical pipe couplings (Victaulic type) and fittings may be installed in place of flanged systems at above locations and in approved services on this project. Grooved-end pipe shall not be used underground or underwater unless indicated otherwise on the Plans.

Pipe and fittings shall be cut grooved. Method of grooving shall be in accordance with mechanical pipe coupling manufacturer's specifications. Pipe to be grooved shall have wall thicknesses not less than the minimum recommended by the coupling manufacturer for cut-grooving. Connections to valves and flanged-end pipe shall be by grooved-end to flanged pipe adapter flange or flanged adapter nipple. Grooved pipe and fitting ends shall be lightly coated with lubricant approved by the coupling manufacturer prior to placing gasket.

Grooved-end pipe shall be supported in accordance with manufacturer's recommendations. In addition, at least one support shall be used between any two couplings.

The Contractor shall submit for review complete information showing fittings, gaskets, mechanical pipe couplings, grooving of pipe and pipe lining or coating prior to installation of any pipe. All materials proposed for use are subject to the Engineer's approval.

Mechanical pipe couplings and grooved-end pipe shall be installed in accordance with the coupling manufacturer's representative's recommendations.

150202 GROOVED-END STEEL PIPE COUPLINGS AND FITTINGS

Steel pipe may be grooved-end and joined by mechanical pipe couplings. Mechanical couplings shall be self-centering and shall engage and lock in place the grooved pipe and pipe fitting ends in a positive watertight couple. Coupling housing clamps shall be fabricated in two or more parts of malleable iron castings, in accordance with ASTM A 47, Grade 32510. Coupling assembly shall be securely held together by two or more steel bolts and nuts of heat-treated carbon steel. Nuts and bolts shall be in accordance with ASTM A 183 and A 194, Grade 2.

Couplings shall hold in place a composition water-sealing gasket designed so that internal water pressure serves to increase the seal's water tightness.

Gaskets for use with cement lined steel pipe shall be captured between the ends of the pipe to protect the exposed metal from corrosion. Gaskets shall be Buna-N in accordance with ASTM D 2000, Grade No. 4AA615A13B13.

All pipe fittings used in connection with pipe couplings shall be radius grooved. Pipe fittings shall be malleable iron castings in accordance with ASTM A 47, Grade II, or ductile iron Grade 60-45-10 in accordance with ASTM A 536.

150210 JOINTS

Steel pipe joints shall be screwed, welded, flanged, or flexible joints as is appropriate to the pipe size and application, except that galvanized pipe shall not be welded. Welding shall be in accordance with AWWA C 206.

Piping shall be made up with a sufficient number of unions, flexible couplings, or flanged joints to permit ready breaking of lines for maintenance in addition to any unions or flanges indicated on the Plans. The Engineer may direct the location of any unions, flexible couplings, or flanged joints, in addition to those indicated on the Plans, at his discretion.

Unions shall be railroad type with bronze-to-iron seat, galvanized if used with galvanized pipe. Flanged joints may be used instead of unions.

Unless otherwise specified or indicated on the Plans, pipe joints shall be of the type specified below. Pipe smaller than 2 inches shall have screwed joints or flexible couplings. Pipe 2 inches through 4 inches shall have screwed, flanged, or welded joints, or flexible couplings. Pipe larger than 4 inches shall have flanged or welded joints or flexible couplings.

Threading shall be done with clean, sharp dies. Pipe threads carelessly made, wavy, rough, or chewed shall be rejected. All screwed joints shall be tightly and neatly made up with an application of Teflon tape or approved paste compound applied to the male threads only, except that liquid and dry chlorine lines and liquid LPG lines shall be made up with litharge and glycerine.

Flanges shall come together at the proper orientation with no air gaps between the flanges after the gaskets are in place. The fit shall not be made by springing any piping, nor shall the orientation alignment be corrected by taking up on any flange bolts. Flange bolts shall slip freely into place with absolutely no binding. If the proper fit is not obtained, the piping shall be altered. Machined flanges or tapered fillers shall be used to accomplish changes in grade or to slope lines for drainage.

All welded joints shall be electric welded. Welding shall be in accordance with AWWA C 206. Qualification of welders shall be as covered in AWWA C 206. All testing of welders shall be at the Contractor's expense, including cost of test nipples, welding rod, and equipment.

150220 FITTINGS

Fittings used with screwed pipe shall be 150 pounds malleable iron banded screwed fittings in accordance with ANSI B 16.3, galvanized in accordance with ASTM A 153 if used with galvanized pipe, or cast iron drainage screwed fittings in accordance with ANSI B 16.12, galvanized in accordance with ASTM A 153 if used with galvanized pipe. Drainage fittings shall be used with drain lines, and other lines which are required to be graded.

Flanged fittings 12 inches and smaller shall be 125 pounds cast iron flanged fittings in accordance with ANSI B 16.1 or 150 pounds steel flanged fittings in accordance with ANSI B 16.5. Flanged fittings for pipe larger than 12-inch may be as above or may be fabricated from sections of steel pipe in accordance with AWWA C 208, with flanges as specified in AWWA C 207.

Companion flanges 4 inches and smaller may be 125 pounds screwed cast iron companion flanges in accordance with ANSI B 16.1 or 150-pound slip-on or welding neck steel flanges in accordance with ANSI B 16.5, except that ammonia type flanges shall be used on chlorine liquid or gas piping. Companion flanges for pipe from 4 inches to and including 12 inches shall be slip-on or welding neck flanges in accordance with ANSI B 16.5.

Companion flanges for pipe larger than 12 inches may be as above or may be steel plate or raised hub flanges in accordance with AWWA C 207.

Slip-on flanges shall be attached to pipe by two fillet welds, in accordance with AWWA C 207. Welding neck flanges shall be secured by full penetration butt welds without backing rings. After welding in place, the faces of flanges shall be perpendicular to the axis of the pipe, or, in the case of fittings, at the proper angle to each other, and bolt holes shall be in proper alignment. Flanges shall be shop welded to pipe or fittings before lining is applied.

Machined flanges or tapered fillers shall be used to accomplish changes in grade, or to slope lines for drainage.

Flange bolts shall be zinc coated or galvanized in accordance with ANSI B 16.1, except that flanges underground or in water shall have Type 304 or Type 316 stainless steel, or Everdur bolts and nuts.

All flange bolts shall be cut and finished to project not more than 1/4 inch beyond outside face of nut after joint is assembled. Where cap screws or stud bolts are required, flanges shall be provided with tapped holes for such cap screws or stud bolts.

Gaskets shall be ring gaskets of 1/16-inch Cranite, Garlock, or equal.

Welding fittings for pipe 8 inches and smaller in size shall be butt-welding fittings in accordance with ANSI B 16.9, standard wall or standard weight. Welding fittings for pipe larger than 8 inches shall be butt-welding fittings in accordance with ANSI B 16.9, or may be made up out of sections of pipe welded together, except where smooth bends are indicated in air lines.

Fittings made up of sections of pipe welded together shall be made of pipe of at least the same wall thickness as the pipe with which used, and bends shall be miter bends, fabricated in accordance with AWWA C 208 and as supplemented by AWWA Manual No. M11. Welding of these made-up fittings shall be in accordance with AWWA C 206.

Outlets and four branch fittings shall be designed and fabricated in accordance with AWWA Manual No. M11.

150230 LINING

Except as otherwise provided, lining in steel pipe shall be as follows.

150231 CEMENT MORTAR LINING

Steel pipe specified or shown on the Plans to be cement mortar lined may be shop lined in accordance with AWWA C 205, or lined after installation by means of a pipe lining machine. If a lining machine is used, it

must be approved by the Engineer and be capable of applying a lining comparable in density and smoothness and of the same thickness as the above specified shop applied lining. In-place lining shall conform to applicable portions of AWWA C 602.

150240 PIPE COATING

Aboveground steel pipe shall be painted as provided in DIVISION 9 of these Specifications.

Except as otherwise provided, all buried steel pipe shall be protected by the following coating systems applied in strict accordance with the manufacturer's instructions.

Buried steel pipe coating shall be epoxy coating and shall extend 6 inches above finish grade or finish floor, and shall be neatly terminated.

Before coating, pipe surface shall be free of dust, dirt, loose rust, moisture, welding residue, oil, and grease. Surface shall then be power tool cleaned or commercial blast cleaned to conform to SSPC Specification SP-3 or SP-6.

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, fabrication, installation, and testing of fusion-bonded epoxy lined and coated steel pipe used inside and outside of pressure reducing stations and meter stations. Size range is 4- to 12-inch nominal pipe size.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Standard Drawings.
- B. Record Drawings and Submittals: STD SPEC 01300.
- C. Miscellaneous Metalwork: STD SPEC 05121.
- D. Painting and Coating: STD SPEC 09900.
- E. Polyethylene Sheet or Tube Encasement: STD SPEC 09954.
- F. Corrosion Control for Buried Piping: STD SPEC 13110.
- G. General Piping Requirements: STD SPEC 15050.
- H. Flexible Pipe Couplings: STD SPEC 15122.
- I. Disinfection of Piping: STD SPEC 15141.
- J. Pressure Testing of Piping: STD SPEC 15144.
- K. Installation of Steel Transmission Pipe: STD SPEC 15251.

1.03 SUBMITTALS

- A. Submit submittal packages in accordance with Standard Specification Section 01300.

- B. Submit piping layout drawings showing location and dimensions of all pipe and fittings. Include laying lengths of valves and other equipment determining piping dimensions. Label or number each fitting or piece of pipe and provide the following information for each item:
 - 1. Material of construction, with ASTM or API reference and grade.
 - 2. Wall thickness of steel pipe and fittings.
 - 3. Details of epoxy lining and coating, thickness, materials, and testing.
 - 4. Manufacturer's certificates of compliance with referenced pipe standards, e.g., ASTM A 53, ASTM A 135, API 5L.
 - 5. Call out all weld sizes and dimensions of grooved ends, flanges, fittings, and joint harnesses.
- C. Submit coating application test records for measuring coating thickness and holiday detection for each pipe section and fitting. Describe repair procedures used.

1.04 INSPECTION AND FIELD VERIFICATION

- A. The District's Representative or his authorized representative may inspect materials, fabrication, and testing at the manufacturer's plant.
- B. Where new pipelines are to be connected to existing waterlines of the District, the Contractor shall verify in the field the location, elevation, pipe material, pipe outside diameter, and any other characteristics of the existing waterline before proceeding with the pipe fabrication or installation. This field verification shall be performed in the presence of the District's Representative. Adjust and align the new piping as necessary to meet the field conditions and provide all required material, labor, and equipment to make the connection.

PART 2 - MATERIALS

2.01 STEEL PIPE

Pipe shall be black carbon steel conforming to ASTM A 53, Type E or S, Grade B; API 5L, Grade B; or ASTM A 135, Grade B. Pipes shall be standard weight per ASME B36.10.

2.02 STEEL FITTINGS

- A. Steel fittings are defined as a special piece of pipe other than a normal straight section. Elbows, crosses, tees, and reducers are fittings.
- B. Fittings shall be butt-welded conforming to ASME B16.9. Material shall be wrought steel conforming to ASTM A 234, Grade WPB. Wall thickness shall be the same as the pipe.

2.03 SHOP APPLIED EPOXY LINING AND COATING

Lining and coating shall be a 100% solids, thermosetting, fusion-bonded, dry powder epoxy resin. Provide Scotchkote 134 or 206N, Lilly Powder Coatings "Pipeclad 1500 Red", or District approved equal. Epoxy lining and coating shall meet or exceed the following requirements

Hardness (Minimum)	Barcol 17 (ASTM D 2583) Rockwell 50 ("M" Scale)
Abrasion Resistance (Minimum)	1,000 cycles: 0.05 gram removed 5,000 cycles: 0.115 gram removed ASTM D 1044, Tabor CS 17 wheel, 1,000 gram weight
Adhesion (Minimum)	3,000 psi (Elcometer)
Tensile Strength	7,300 psi (ASTM D 2370)
Penetration	0 mil (ASTM G 17)
Adhesion Overlap Shear, 1/8-inch steel panel, 0.010 glue line	4,300 psi (ASTM D 1002)
Impact (Minimum Value)	4,300 psi (ASTM D 1002)

2.04 SHOP AND FIELD APPLIED EPOXY COATING FOR PATCHING

Use a two-component, 80% solids, liquid epoxy resin, such as Scotchkote 306 or District approved equal.

2.05 FLANGES

- A. Provide flanges that match the flange of the connecting valve or other equipment.
- B. Provide welding neck flanges for attachment to wrought steel fittings. Provide welding neck or slip on flanges for attachment to pipe. Slip on flanges shall be double welded. Flange material shall conform to ASTM A 105, A 181, or A 182. Flanges shall be flat faced.
- C. Class 150 flanges shall comply with AWWA C207, Class E or ASME B16.5, Class 150.
- D. Class 300 flanges shall comply with AWWA C207, Class F or ASME B16.5, Class 300.

2.06 BOLTS, NUTS AND GASKETS FOR FLANGES

See Standard Specification Section 15050.

2.07 INSULATING FLANGE KITS

See Standard Specification Section 13110.

2.08 OUTLETS

- A. For threaded outlets 3 inches and smaller, use a thredolet type per AWWA Manual M11 (Current Edition), Chapter 13. Outlets shall be 3000 pound WOG forged steel per ASTM A 105 or ASTM A 216, Grade WCB. Threads shall comply with ASME B1.20.1, NPT. Outlets shall be Bonney Forge Co. "Thredolet," Allied Piping Products Co. "Branchlet," or District approved equal. Do not use pipe couplings for outlets.
- B. For flanged outlets 4 inches and larger, use a tee with a welding neck flange.

2.09 MECHANICAL CLAMP-TYPE COUPLINGS

- A. Mechanical clamp-type couplings for grooved end pipe shall be ductile iron, ASTM A 536, Grade 65-45-12. Bolts shall conform to ASTM A 183, 110,000 psi tensile strength. Gaskets shall be EPDM (ethylene propylene diene monomer) conforming to ASTM D 2000. Couplings shall conform to AWWA C606 for flexible, square cut grooved joints in IPS steel pipe. Couplings shall be Victaulic Style 77, or District approved equal. Line and coat couplings the same as the pipe. Color shall match the color of the pipe fusion epoxy coating.

2.10 TYPE OF PIPE JOINTS

- A. Joints in vaults shall be flanged to connect to valves and other equipment.
- B. Joints between pipe, fittings, and welding neck flanges shall be full penetration butt welds. Joints between pipe and slip on flanges shall be fillet welds to the interior and exterior. Do not field weld to join components.
- C. Provide grooved end pipe where mechanical clamp-type couplings are to be used. Grooved end joint shall be flexible, square cut per AWWA C606, Table 2. Apply 10 mils maximum of fusion epoxy coating to the grooved end pipe surface.
- D. Provide plain end pipe where flexible pipe couplings are to be used. Couplings and harnesses shall conform to Standard Specification Section 15122. Line and coat couplings and harnesses the same as the pipe. Color shall match the color of the pipe fusion epoxy coating.

2.11 POLYETHYLENE ENCASEMENT

See Standard Specification Section 09954.

PART 3 - EXECUTION

3.01 FABRICATION, ASSEMBLY, AND ERECTION

- A. Beveled ends for butt welding shall conform to ASME B16.25. Remove slag by chipping or grinding. Surfaces shall be clean of paint, oil, rust, scale, slag, and other material detrimental to welding. When welding the reverse side, chip out slag before welding.

- B. Fabrication shall comply with ASME B31.3, Chapter V. Welding procedure and performance qualifications shall be in accordance with Section IX, Articles II and III, respectively, of the ASME Boiler and Pressure Vessel Code.
- C. Apply full penetration weld to exterior joint of butt welded pipe, fittings, and welding neck flanges. Apply fillet welds to the interior and exterior circumference of the pipe and slip on flanges. Minimum size of fillet weld shall be equal to the steel cylinder thickness. Complete each pass around the entire circumference of the pipe before commencing the next pass. Use electrodes recommended by the pipe fabricator. Do not deposit more than 1/8-inch of throat thickness per pass. The minimum number of passes or beads in the completed weld shall be as follows:

Steel Cylinder Thickness
(inches)

Minimum Number of Passes
for Welded Joints

0.2500 and Less	2
Greater than 0.2500	3

- D. Use the shielded metal arc welding (SMAW) process for welding.
- E. Welding preparation shall comply with ASME B31.3, paragraph 328.4. Limitations on imperfections in welds shall conform to the requirements in ASME B31.3, Table 341.3.2, and paragraph 341.4 for visual examination.
- F. Identify welds in accordance with ASME B31.3, paragraph 328.5.
- G. Clean each layer of deposited weld metal prior to depositing the next layer of weld metal, including the final pass, by a power-driven wire brush.
- H. Welding electrodes shall comply with AWS A5.1.
- I. After shop fabrication and prior to shop applied epoxy, test each welded joint by the liquid penetrant method. Conform to the requirements specified in ASTM E 165. The materials used shall be either water washable or nonflammable. Products: "Spotcheck" by the Magnaflux Corporation or "Met-L-Check Flaw-Findr" by the Met-L-Check Company. Chip out all defects, reweld, and retest the section affected until it shows no leaks or other defects.

3.02 SHOP APPLICATION OF FUSION-BONDED EPOXY

- A. Apply lining and coating per AWWA C213 except as modified herein.
- B. Grind 0.020-inch (minimum) off the weld caps on the pipe weld seams before beginning the surface preparation and heating of the pipe.
- C. Grind surface irregularities, welds, and weld spatter smooth before applying the epoxy. The allowable grind area shall not exceed 0.25 square foot per location, and the maximum total grind area shall not exceed 1 square foot per pipe section. Do not use any pipe section in which these requirements cannot be met.
- D. Grind outside sharp corners, such as the outside edges of flanges and harness plates, to a minimum radius of 1/4-inch.
- E. Uniformly preheat the pipe prior to blast cleaning to remove moisture from the surface. The preheat shall be sufficient to ensure that the pipe temperature is at least 5°F above the dew point temperature during blast cleaning and inspection.
- F. Sandblast surfaces per SSPC SP-5. Protect beveled pipe ends from the abrasive blast cleaning.
- G. Apply a phosphoric acid wash to the pipe after sandblasting. The average temperature of the pipe, measured in three different locations, shall be 80°F to 130°F during the acid wash procedure. The acid wash shall be a 5% by weight phosphoric acid solution. The duration in which the acid is in contact with the pipe surface shall be determined by using the average pipe temperature as tabulated below:

b.	a. Pipe Temperature (°F)	c. Contact Time d. (seconds)
	e. 80	f. 52
	g. 85	h. 45
	i. 90	j. 36
	k. 95	l. 33
	m. 100	n. 28
	o. 105	p. 24
	q. 110	r. 21
	s. 130	t. 10

After the acid wash has been completed, remove the acid from the pipe with demineralized water having a maximum conductivity of 5 micromhos/cm at a minimum nozzle pressure of 2,500 psi.

- H. Apply epoxy lining and coating by either the electrostatic spray or fluidized bed process. Minimum thickness of lining and coating shall be 12 mils each, except for grooved end pipe surfaces. Heat and cure per the epoxy manufacturer's recommendations. The heat source shall not leave a residue or contaminant on the metal surface. Do not allow oxidation of surfaces to occur prior to lining and coating. Do not permit surfaces to flash rust before lining and coating.

3.03 QUALITY OF LINING AND COATING APPLICATIONS

The cured lining and coating shall be smooth and glossy, with no graininess or roughness. The lining and coating shall have no blisters, cracks, bubbles, underfilm voids, mechanical damage, discontinuities, or holidays.

3.04 SHOP TESTING OF LINING AND COATING

- A. Test lining and coating with a low-voltage wet sponge holiday detector in accordance with AWWA C213, Section 5.3.3. If the number of holidays or pinholes is fewer than one per 10 square feet of coating surface, repair the holidays and pinholes by applying the coating manufacturer's recommended patching compound to each holiday or pinhole and retest. If the number of holidays or pinholes exceeds one per 10 square feet, remove the entire pipe lining and coating and recoat the entire piping and retest.
- B. Check for coating defects on the weld seam centerlines. There shall be no porous blisters, craters, or pimples lying along the peak of the weld crown.
- C. Measure the lining and coating thickness at three locations on each pipe section using a coating thickness gauge calibrated at least once per eight-hour shift. Record each measured thickness value. Where individual measured thickness values are less than the specified minimum thickness, measure the coating thickness at 6-inch intervals along the pipe length. The average of these measurements shall exceed the specified minimum thickness value, and no individual thickness value shall be more than 2 mils below or 3 mils above the specified minimum value. If a section of pipe does not meet these criteria, remove the entire lining and coating and recoat the entire pipe section or fitting.

- D. The District's Representative will conduct in the field an independent inspection of the lining and coating for compliance with the above criteria. Coated items failing his inspection will be cause for rejection.

3.05 DELIVERY AND TEMPORARY STORAGE OF PIPE

Lift pipe with wide belt slings. Do not use cable slings or chains. Support the pipe on padded wooden blocks. Do not roll or drop the pipe on the ground or allow the pipe to fall from the delivery trucks. Protect the lining and coating of the pipe from damage or scratches. Cover pipe with plastic sheets and secure until ready for installation.

3.06 INSTALLING BURIED PIPE

See Standard Specification Section 15251 for installation requirements of buried steel pipe. Install the pipe with polyethylene encasement and other appurtenant items for the installation. Inspect the lining and coating, and repair damaged areas in the field as described herein.

3.07 INSTALLING PIPE IN VAULTS

- A. Install pipe in vaults without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Provide temporary supports and place the assembled piping at the correct grade and position in the vault.
- B. Provide pipe supports per Standard Specification Section 05121.

3.08 INSTALLING FLANGED JOINTS

See Standard Specification Section 15050 for installation instructions.

3.09 INSTALLING INSULATING FLANGE KITS

Install insulating flange kits with coatings per Standard Specification Section 13110.

3.10 INSTALLING MECHANICAL CLAMP-TYPE COUPLINGS

- A. Install mechanical clamp-type couplings in accordance with the manufacturer's recommendations and the following.
- B. Clean oil, grease, and dirt from the grooved ends of pipe. Repair any damage or holidays in the shop applied coating before installing couplings. Apply the coupling manufacturer's gasket lubricant to the gasket exterior including lips, pipe ends, and housing interiors.
- C. Lubricate threads of bolts and nuts with oil or graphite prior to installation. Uniformly tighten bolts and nuts alternately and evenly until coupling segments are seated. Apply torque to nuts with a calibrated torque wrench as recommended by the coupling manufacturer.

3.11 INSTALLING FLEXIBLE PIPE COUPLINGS

Install flexible pipe couplings and joint harnesses where shown per Standard Specification Section 15122.

3.12 FIELD REPAIRS TO LINING AND COATING

Patch scratches and damaged areas incurred while installing fusion-bonded epoxy pipe with a two-component, 80% solids (minimum), liquid epoxy resin. Wire brush or sandblast the damaged areas per SSPC SP-10. Lightly abrade or sandblast the pipe lining and coating on the sides of the damaged area before applying the liquid epoxy coating. Apply the liquid epoxy coating to damaged linings and coatings to areas smaller than 20 square inches. Patched areas shall overlap the parent or base coating a minimum of 1/2-inch. If a damaged area exceeds 20 square inches, remove the entire pipe lining and coating and recoat the entire piping and retest. Apply the liquid epoxy coating to a minimum dry-film thickness of 12 mils.

3.13 PAINTING AND COATING

Coat exterior surfaces of fusion-bonded epoxy pipe in vaults per Standard Specification Section 09900, System No. 10. Apply finish coat in field. Do not apply prime coat.

Coat exterior surfaces of mechanical clamp-type couplings, flexible pipe couplings, and joint harnesses the same as the adjacent pipes.

3.14 PRESSURE TESTING

See Standard Specification Section 15144 for pressure testing requirements. Test pipe at the same time that the primary pipelines are tested.

3.15 DISINFECTION

See Standard Specification Section 15141 for chlorination requirements.

150241 CEMENT MORTAR COATING

Steel pipe specified or shown to be cement mortar coated shall be coated in accordance with AWWA C 205 modified as follows:

Portland cement shall conform to ASTM C 150, Type II, low alkali.

Sand shall conform to the requirements of AWWA C 205 except that the total percentage of all deleterious material shall not exceed 3 percent.

150800 COPPER PIPE AND TUBING

Except as otherwise specified or shown on the Plans, copper pipe and tubing shall be as follows: copper pipe for the conveyance of water or aqueous solutions shall conform to the requirements of ASTM B 88 as detailed below.

Copper lines shall be neatly supported as shown on the Plans or at such intervals as to prevent sagging. Tube shall be cut square with hacksaw or disc cutter and shall be reamed full size and burrs removed. If

necessary, a sizing tool shall be used to correct any distortion. The outside surface of the end of the pipe and the inside surface of solder fittings shall be cleaned with steel wool until the metal is bright. Soldering flux shall be applied to the cleaned surfaces of pipe and fittings in a thin, uniform, complete coating. After the pipe has been inserted in the fitting as far as it will go, the fitting shall be twisted on the pipe to help spread the flux uniformly. The fitting shall be heated until it reaches the correct temperature to melt the solder. The flame shall then be removed and the solder applied to the edge of the fitting or to the solder hole in the fitting, if there is one, and the joint completely filled with solder. When the solder has congealed to a plastic state, the excess metal shall be removed with a cloth or brush. Joints shall not be quenched after soldering.

All copper lines shall be cleaned with high-pressure air after first disconnecting piping at instruments, filters, pressure reducers, valve operators, and other special devices.

All copper lines shall be tested in the same manner as the piping system to which they connect, except that instrument air lines may be tested by use of a halide torch or other device after charging the lines with Freon.

150810 ASTM B 88 TUBING

All exposed copper pipe or tubing conforming to ASTM B 88 shall be Type L hard-drawn, rigid, seamless copper water tubing.

Copper tubing buried in the ground or in plastic conduit shall conform to the same specification but shall be Type K soft-annealed.

Fittings shall be Hoke "Gyrolok," Crawford Fitting Company "Swagelok," or equal, or solder type forged or wrought copper. Solder shall be ASTM B 32, Alloy Grade 5A.

Copper pipe connected to ferrous pipe or valves, or other noncopper items shall be connected by means of dielectric insulating unions or fittings as manufactured by the Patrol Valve Company, Mueller Company, or equal.

When making connections to meters or other devices having iron pipe size threaded fittings, special thread to tube adapters shall be used. Such adapters shall be Crawford Fitting Company "Swagelok," Hoke "Gyrolok," or equal.

151700 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

HDPE Pipe shall be manufactured with pipe resin conforming to the requirements of ASTM D 3350-05 with a minimum cell classification of 445474C. Pipe shall be manufactured to the dimensions as found in ASTM F-714. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipe service factors for determining pipe pressure rating shall be a minimum of 0.63. Pipe shall have minimum pressure ratings as follows:

DR 11	200 psi
DR 13.5	160 psi
DR 15.5	138 psi
DR 17	125 psi
DR 19	111 psi
DR 21	100 psi
DR 26	80 psi

HDPE pipe shall be tested at the pressure listed in the piping schedule.

151710 FITTINGS FOR HDPE PIPE

1. Butt Fusion Fittings - Fittings shall be made from HDPE pipe resin meeting ASTM D 3350-05 with a cell classification of 445574C, Butt Fusion Fittings shall have a manufacturing standard of ASTM D-3261. Molded & fabricated fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans. Fabricated fittings must have the same pressure rating as the pipe. Fabricated fittings are to be manufactured using a Data Logger to record temperature, fusion pressure, and a graphic representation of the fusion cycle shall be part of the Quality Control records.
2. Electrofusion Fittings - Fittings shall be made from resin or pipe meeting ASTM D 3350-05 with a cell classification of 445574C.; Electrofusion Fittings shall meet the manufacturing standard of ASTM F-1055. Fittings shall have the same pressure rating as the pipe or higher unless otherwise specified on the plans.
3. Flanged and Mechanical Joint Adapters - Flanged and Mechanical Joint Adapters shall be made from materials containing resin that meets ASTM D 3350-05 with a cell classification of 445574C.

Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe supplier's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe supplier, including, but not limited to, temperature requirements of indicated in TR 33-2005. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself. All field welds shall be made with fusion equipment equipped with a Data Logger. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the Quality Control records.

Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe supplier's literature. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused. The size of the heating iron shall be larger than the size of the outlet branch being fused.

Mechanical joining will be used where the butt fusion method cannot be used. Mechanical joining will be accomplished by either using a HDPE flange adapter with a Ductile Iron back-up ring or HDPE Mechanical Joint adapter with a Ductile Iron back-up ring.

Socket fusion, hot gas fusion, threading, solvents, and epoxies will not be used to join HDPE pipe.

151800 PLASTIC PIPE, TUBING, AND FITTINGS

Except as otherwise specified herein, or as called for on the Plans, plastic pipe, tubing, and fittings shall be as follows.

Extruding and molding material shall be virgin material containing no scrap, regrind, or rework material except that, where permitted in the referenced standard specifications, clean rework material generated from the manufacturer's own operations may be used as long as the end product meets the requirements of this specification. Pipe and tubing, except for drainage pipe, shall meet the requirements of the National Sanitation Foundation Testing Laboratories Inc. and shall bear the "NSF" seal.

All plastic pipe delivered to the jobsite shall be plainly marked as to nominal pipe or tubing size, type, class, schedule or pressure rating, and manufacturer.

Fittings shall be of the same material as the pipe and of equal or greater pressure rating, except that drainage waste and vent (DWV) fittings need not be pressure rated; and all fittings shall conform to the appropriate ASTM Specification. In general, fittings for rigid pipe shall be socket type for solvent or fusion welding, and fittings for nonrigid pipe shall be insert or flare fittings as specified or approved by the Engineer.

Transitions from plastic to metal or IPS pipe shall be by molded transition fittings, not by threading the plastic pipe. Unions 2-2/2 inches and smaller shall be socket end screwed unions, and unions 3 inches and over shall be made up of socket flanges with 1/8-inch full face soft rubber gasket. Unions shall be located where shown on the Plans and elsewhere as directed by the Engineer for adequate access to the piping system for inspection and cleaning.

Nipples for transition from plastic pipe to rubber hose shall be serrated.

151810 POLYVINYL-CHLORIDE (PVC) PIPE AND FITTINGS

PVC pipe shall be Schedule 40 or Schedule 80 as specified, PVC 1120, conforming to the requirements of ASTM D 1785 and appendices thereto. Pipe shall be extruded from Type I, Grade 1, Class 12454 material as specified in ASTM D 1784.

Fittings shall conform to ASTM D 2466 or D 2467 for pressure fittings, or to D 2665 for DWV fittings as is appropriate to the service and pressure requirement.

PVC pipe shall be tested at the pressure listed in the piping schedule.

151810.10 CLASS 235 PVC PIPE

PVC Class 235 pipe shall meet the requirements of ASTM D 2241 except that the pipe shall have outside diameters of ductile iron pipe sizes instead of iron pipe sizes. PVC pipe of 4-inch through 12-inch diameter shall meet the requirements of AWWA C 900 with pressure class of 235 and DR of not less than 18. PVC pipe of 14-inch through 24-inch diameter shall meet the requirements of AWWA C 905 with pressure class of 235 and DR of not less than 18. C-900 pipe shall be capable of withstanding without failure 4 times the pressure class of the pipe of hydrostatic pressure for a minimum of 5 seconds. The integral bell shall be tested with the pipe.

Provisions shall be made for contraction and expansion at each joint with a rubber ring and integral

thickened bell as part of each joint. The rubber ring shall meet the requirements of ASTM D 1869. The bell section shall be at least as strong as the pipe barrel.

At least 85 percent of the total footage of pipe shall be furnished in standard lengths of 20 feet. The remaining footage of pipe may be in random lengths of not less than 10 feet long.

Sizes and their respective dimensions shall be as specified in the following tabulation:

C-900 Class 235 DR 18

<u>Nominal Pipe Size (Inches)</u>	<u>Outside Pipe Diameter (Inches)</u>	<u>Minimum Pipe Wall Thickness (Inches)</u>
4	4.80	0.267
6	6.90	0.383
8	9.05	0.503
10	11.10	0.617
12	13.20	0.733

C-905 Class 235 DR 18

<u>Nominal Pipe Size (Inches)</u>	<u>Outside Pipe Diameter (Inches)</u>	<u>Minimum Pipe Wall Thickness (Inches)</u>
14	15.30	0.850
16	17.40	0.967
18	19.50	1.083
20	21.60	1.200

151810.15 FITTINGS FOR PVC PIPE

Fittings for PVC pipe shall be cast iron fittings as specified under cast iron and ductile iron pipe in these Specifications and properly sized for the dimensions of the pipe being used. All fittings for joining pipe 4 inches in diameter and larger shall be of the push-on rubber gasket or mechanical joint type of joint.

151810.20 PVC PIPE LEAKAGE TEST

All PVC pipe shall be tested for leakage at 150 psi per AWWA C 605-97, measured at the lowest point in the line. Any sections of pipelines indicating more than the allowable leakage shall be repaired and retested until the leakage is less than the allowable indicated below. The leakage test shall be for a minimum duration of 2 hours. The leakage test shall be made after backfilling. Any visible leaks shall also be repaired.

<u>Pipe Diameter (inches)</u>	<u>Allowable Leakage (gallons/100 joints/hour)</u>
4	0.33
6	0.50
8	0.66
10	0.83

12	0.99
14	1.16
16	1.32
18	1.49
20	1.66
24	1.99

151820.20 JOINTS

The PVC gravity-type sewer pipe joints shall be bell and spigot with a rubber gasket ring, providing a watertight seal. The spigot end of the pipe shall be marked by the manufacturer to identify the final, in-place position of the spigot in the bell. The lubrication and assembly of the joints shall be in accordance with the manufacturer recommendations.

151820.25 MANHOLE CONNECTIONS

A clamp stainless steel gasket or rubber boot type gasket as shown on the plans shall be provided at manhole entry or connection to impede infiltration and exfiltration. Where precast manholes are used, entrance holes shall be large enough to allow for proper grouting around the manhole gasket.

151820.30 CERTIFICATION

A certification from the manufacturer shall be furnished attesting that the pipe and fittings meet the requirements of this Specification and ASTM F 679 Type T-2. A certificate shall be provided for each lot or every 5,000 feet of pipe delivered to the jobsite.

151820.40 IMPERFECTION

Any imperfections which, in the opinion of the Engineer, may adversely affect the performance of the PVC gravity-type sewer pipe, joints, or fittings shall be cause for rejection.

The Contractor shall prevent scoring of the pipe surfaces and pipe distortion. If such defects occur, the pipe will be rejected.

151820.50 MARKINGS

All PVC gravity-type sewer pipe shall be delivered to the site of the Work with markings as required by ASTM F 679. Markings shall include the following:

- A. Manufacturer's name.
- B. Code number identifying production control and plant location.
- C. Nominal pipe size.
- D. PVC cell classification.

E. Label “Type PSM SDR 35 PVC Sewer Pipe”, or a lesser SDR

F. Label “ASTM F 679.”

Fittings shall be identified as the pipe except for the PVC cell classification requirement.

151820.60 MANUFACTURE

Written verification of date of manufacture for all PVC gravity sewer pipe and fittings shall be provided for each pipe lot delivered to the project. Manufacture shall be within four months of installation.

151820.70 STORAGE

All PVC gravity sewer pipe and fittings, from time of manufacture to time of installation, shall be protected from sunlight. The pipe shall not be stored in a hot location which will cause distortion of pipe.

In addition to the required tests at the manufacturer's plant, the Engineer will select specimens at random from each lot of pipe and fittings delivered to the jobsite. Tests on these specimens shall be in accordance with methods defined in ASTM F 679.

Tests to be performed at a local testing facility, approved by the Engineer, shall be as deemed necessary by the Engineer and under the supervision of the Engineer. The cost of the Engineer's supervision will be borne by the Owner and all other costs shall be borne by the Contractor.

151900 PIPELINE TESTING

Following completion of the backfill operation, the sewer pipe shall be tested by the following methods.

151910 LIGHT TEST

After the trench has been backfilled to one foot above the top of the pipe as specified in Section 2 of these specifications, a light test shall be made between manholes to check alignment and grade of the pipe. The completed pipeline shall be such that true circle of light can be seen from one manhole to the next. If alignment or grade is other than specified and displacement of pipe is found, the Contractor shall correct such defects at his own expense. A light test may also be required after backfill is completed, if backfilling procedures are such as to damage or displace the line.

151920 INFILTRATION TEST

Where groundwater is above the water line, tests will be made by sealing off sections of line between manholes and measuring the actual flow of water by collecting or pumping the discharge into barrels or by other proven methods. Tests shall be continued for a period of at least four hours for each section tested. Sufficient time shall be allowed to soak lines and manholes in advance of performing tests. The maximum allowable infiltration, including manholes, shall not exceed ten (10) gallons per day per mile of sewer per inch of pipe diameter.

151930 LOW PRESSURE AIR TEST

All PVC gravity type sewer pipe shall be tested using low pressure air to provide assurance that the pipe is free from significant leaks. The Contractor shall test each section of pipe from manhole to manhole

after the pipe has been thoroughly cleaned and backfill is completed and compacted. The Contractor shall test each section of pipe from manhole to manhole after the pipe has been thoroughly cleaned and backfill is completed and compacted. The Contractor shall furnish all the necessary equipment to perform the test, including an accurate pressure gauge with divisions of 0.10 psi. All wyes, tees, and lateral stubs shall be capped and braced to withstand test pressures. All pipe outlets shall be plugged with either mechanical or pneumatic plugs and securely braced.

Begin the test by slowly adding air until the internal air pressure is approximately 4 psig. Allow at least two (2) minutes for internal air temperature to stabilize, adding only the amount of air required to maintain pressure. Disconnect the air supply. When the gauge pressure decreases to 3.5 psi, start timing. Record the time required for the pressure to fall to 2.5 psig. Compare the test time to the specification time in the following table for the appropriate size and length of pipe being tested.

LOW PRESSURE AIR TEST
Specification Time Requirement for a 1.0 psig Pressure Drop (Min:Sec)

<u>Length</u>	<u>NOMINAL PIPE SIZE</u>				
	<u>12"</u>	<u>15"</u>	<u>18"</u>	<u>21"</u>	<u>24"</u>
100 ft	11:20	14:10	17:00	19:50	22:47
150 ft	11:20	14:10	19:13	26:10	34:11
200 ft	11:24	17:48	25:38	34:54	45:34
250 ft	14:15	22:15	32:03	43:37	56:58
300 ft	17:05	26:42	38:27	52:21	68:22
350 ft	19:56	31:09	44:52	61:00	79:46
400 ft	22:47	35:36	51:16	69:48	91:10
450 ft	25:38	40:04	57:41	78:31	102:33

If the test duration is less than the specified duration above, the sewer line fails the test. The Contractor shall find the source of leakage, repair or replace and retest. Repeat test until sewer line passes. The Contractor shall always conduct this test in the presence of the Engineer or his duly authorized representative.

151940 FIELD QUALITY CONTROL

Defective Materials: where gaskets, joints, pipe or fittings have defects that will adversely affect the performance of the piping system, such defective items shall not be used. Defects include:

1. Scoring of the surface.
 2. Distortion.
- A. Mandrel Tests
1. Contractor shall perform acceptance and final verification mandrel tests in installed pipe as specified hereafter.
 2. The acceptance mandrel test shall be performed:
 - a. After cleaning and completion of other tests.
 - b. After placement and compaction of backfill.

- c. Before construction of placement of surfacing.
 - d. Not sooner than 30 days after pipe installation.
 - e. Not later than 60 days after installation.
3. Final Verification Mandrel Test
- a. Time of Performance
 - 1) Not sooner than 30 days before the end of the warranty period.
 - 2) Not later than 10 days before the end of the warranty period.
 - b. The final verification mandrel test shall be considered a warranty service, and the costs related to this final verification mandrel test shall be understood to have been included in the Contract Price.
4. The mandrel tests and the procedures for unsuccessful tests shall be as specified hereinafter.
- a. Where, as a result of unsuccessful tests, sections of piping are removed and replaced, Contractor shall post a one-year warranty bond in a sum equal to the costs of replacement of the repaired sections to guarantee the quality and performance of such repaired sections.
5. Mandrel: Contractor shall procure a custom fabricated mandrel having the following characteristics:
- a. Rigid with an odd number of legs, minimum 9.
 - b. Minimum length equal to nominal pipe size.
 - c. Circular cross section of diameter specified hereinafter.

MANDREL DIAMETER

Nominal Pipe Size	(NPS)	6	8	10	12	15
Mandrel Diameter,	inches	5.50	7.37	9.21	10.96	13.56
Nominal Pipe Size	(NPS)	18	21	24	27	30
Mandrel Diameter,	inches	16.92	19.95	22.45	25.30	28.50

6. Test Procedure: The mandrel shall be pulled through the line under test by one person, by hand, with reasonable effort, without the aid of mechanical equipment.
- a. Successful test shall be achieved where the mandrel is pulled through the total length of the line under test.
7. Failing Test: Where the mandrel test is not successful, the section of piping with the obstruction shall be removed and replaced, and the piping shall be tested again, including

visible leaks test, pressure test with maximum leakage allowance, mandrel tests, and other specified tests.

- a. Correction of excessive deflection of obstructions by methods other than removal of the affected piping and replacement of the removed piping with new piping will not be accepted.
8. Proof rings: Contractor shall procure custom fabricated proof rings for verification of mandrel diameter.
- b. The proof rings shall be available at the site of the Work during performance of mandrel tests.
 - c. The mandrel diameter shall not vary more than plus or minus one percent of the specified diameter.

152000 RUBBER HOSE

Rubber hose shall be furnished and installed where indicated on the Plans and specified herein. Rubber hose larger than 1-1/2 inches in size shall be Style MHB, as manufactured by the Goodyear Rubber Company; P-293 Non-Twist Fire Hose as manufactured by Uniroyal Inc.; equivalent Goodall Rubber Company; or equal. Rubber hose 1/2-inch through 1-1/2-inch shall be Wingfoot General Purpose as manufactured by Goodyear Rubber Company; P-999 General Purpose Air Hose as manufactured by Uniroyal; equivalent Goodall Rubber Company; or equal. Hose ends shall be equipped and fitted with appropriate combination clamped nipples and threaded ends to make up the assembly shown on the Plans. Hose shall be neoprene or approved oil-resistant material and suitable for a working pressure of not less than 150 pounds per square inch.

152100 PIPING SPECIALTIES

The Contractor shall furnish and install, wherever shown on the Plans, as called for in these Specifications, or as required for proper operation of equipment, all items specified under this heading including gaskets, bolts, caulking materials, hangers, supports, guides, anchors, and such incidental materials and equipment as are required to make the items complete and ready for use.

152110 FLEXIBLE PIPE COUPLINGS

Where shown on the Plans or specified, or elsewhere as approved by the Engineer for the Contractor's convenience, flexible couplings shall be furnished and installed.

Flexible couplings shall be galvanized when on galvanized pipe or on pipe which are epoxy or cement lined, or when underground. When flexible type couplings are used as expansion joints, the ends of the pipe shall be separated to allow for expansion.

For cast iron pipes, flexible couplings shall be Dresser Style 53; Rockwell Series 430; Baker Series 228; or equal.

For steel pipes, flexible couplings shall be Dresser Style 38; Rockwell Series 411; or equal, except where other Styles are required for special conditions. Where indicated on the Plans, flexible couplings shall be suitable for connecting pipes which have different outside diameters.

Flanged coupling adapters shall have not less than two anchor studs each.

Where flexible couplings are installed underground, Type 316 stainless steel bolts shall be used. The entire coupling shall be given a 20-mil coat of T.C. Mastic as manufactured by the Tape Coat Company, Inc.; Bitumastic No. 50 as manufactured by Koppers Company, Inc.; or equal.

Victaulic couplings, to be used where indicated on the Plans, shall be as manufactured by Victaulic Company of America, Gustin-Bacon, or equal. Victaulic couplings for cast iron pipe shall be Style 31. Couplings for steel pipe shall be Style 77. Adapter bands shall be welded to the ends of the steel pipe as necessary to permit proper installation of couplings.

Gaskets for all couplings except those on the air piping system shall be neoprene rubber, or equal. Gaskets for couplings in the air piping system shall be suitable for operation at a temperature of 250 degrees F.

All flexible couplings shall have tie downs unless directed otherwise with a written note on the Plans.

152135 PIPE SADDLES

Pipe saddles shall be furnished and installed where indicated on the Plans. Pipe saddles shall be 101S & 202S service saddles manufactured by ROMAC INDEUSTRIES, INC.; or equal. Pipe saddles shall be Type 304 stainless steel with rubber gaskets. Threads on bolts shall have anti-gall coating. Size of the tapped boss shall be as indicated on the Plans.

152200 PRESSURE GAUGES

Pressure and compound gauges shall be installed as indicated in the PRESSURE GAUGE SCHEDULE on the Plans and as specified herein. Gauges are designated with a mark number in the Pressure Gauge Schedule on the Plans.

This schedule also shows the gauge type, pressure or compound; the gauge range and the applicable construction reference, if any. All gauges shall be dual-range with the scales in feet and pounds per square inch. The units of each scale shall be clearly identified on the gauge face.

All gauges shall be field tested by the Contractor with a calibrated test gauge, in the presence of the Engineer. All gauges shall be installed in strict conformance with these Specifications, and with the manufacturer's instructions.

All gauges shall be not less than 4-1/2 inches in diameter, except where noted otherwise. The gauges shall have back flanged aluminum cases with threaded ring, except if for panel mounting, in which case the gauge shall have a front flanged aluminum case with threaded ring. The case shall be fitted with a rupture disc which shall relieve out the back of the case.

Gauges shall have Type 316 stainless steel bellows or bourdon tube, depending on pressure range. If maximum pressure is not more than 10 pounds per square inch, the gauge shall use bellows as the measuring element. If maximum pressure is not less than 15 pounds per square inch, the measuring element shall be a bourdon tube. Socket tips for bellows and bourdon tube shall be stainless steel. The socket tips of all gauges shall be not less than 1/2-inch size.

All gauges shall be fitted with shatterproof glass.

Pressure gauges shall be Solfrunt Gauges Figure No. 1931T; as manufactured by U.S. Gauge Division of Ametek, Inc.; Ashcroft Figure No. 1379; as manufactured by Dresser Industrial Valve and Instrument Division, Dresser Industries, Inc.; or equal.

Gauges shall be mounted on diaphragm seals where indicated on the Plans.

Diaphragm seals shall have Type 316 stainless steel diaphragm and bottom housing unless otherwise indicated on the Plans. The bottom housing shall be fitted with a flushing connection. This flushing connection shall be fitted with a Type 316 stainless steel close nipple and a cock.

The diaphragm seal gauge assembly shall also be fitted with a snubber. The snubber shall dampen pressure fluctuations in the filled system. All diaphragm seal gauge assemblies shall be filled with silicon and the snubber filter disc shall be sized to prevent the gauge from pulsing violently. The snubber shall be made of stainless steel and shall be as manufactured by Chemiquip, Ashcroft, or equal.

The diaphragm seal shall be an Ashcroft Type 101 as manufactured by Dresser Industrial Valve and Instrument Division, Dresser Industries, Inc.; Type AG as manufactured by Mansfield and Green Division of Ametek, Inc.; or equal.

All pressure gauges, except gauges with diaphragm seals, shall have pulsation dampeners installed between the gauge and the shut-off valve. The pulsation dampeners shall be made of stainless steel.

Pulsation dampeners shall be Ashcroft Figure No. 1106S as manufactured by Dresser Industrial Valve and Instrument Division, Dresser Industries, Inc.; Ray Pressure Snubbers as manufactured by Operation and Maintenance Specialties, Charlotte, North Carolina; or equal.

The Contractor shall submit Shop Drawings to the Engineer for approval. These Shop Drawings shall include information on all items and shall be complete to show that all requirements of the Specifications are being met.

152600 PLUMBING

A complete sanitary plumbing system shall be constructed in accordance with the Plans, these Specifications, International Association of Plumbing and Mechanical Officials Uniform Plumbing Code - Latest Edition, and all applicable State and local codes. These systems shall consist of the fixtures, drains, vents, water pipe connections, cleanouts, fittings, and accessories for the complete plumbing system. The Plans and Specifications shall be modified as required to meet the requirements of the applicable codes.

Installation of all fixtures and accessories shall be roughed in according to dimensions supplied by the manufacturer of the fixture. Each fixture and accessory shall be mounted without cutting of finish surface.

All fixtures except showers shall have stops at the fixture on all services, all fixture fittings and piping which are exposed shall be heavy-duty chrome.

All plumbing lines and piping shall be thoroughly flushed out and left clean, as required by the Health Department. Soil, waste, drain, and vent lines shall be tested as specified by the Uniform Plumbing Code. Water piping shall be tested with water under a pressure of 100 psi. Leaks disclosed by testing shall be

repaired and testing continued until all piping is tight and without leaks. All testing and repairs shall be at the Contractor's expense.

Painting of any plumbing items shall be as specified under DIVISION 9.

152610 SOIL, WASTE, AND VENT PIPING

Soil pipe and fittings above grade shall be no hub cast-iron soil pipe conforming to standards of the Soil Pipe Institute. Waste and vent pipe above grade may be cast iron soil pipe or galvanized steel pipe. Fittings for screwed waste and vent piping shall be cast iron drainage pattern fittings.

Horizontal piping shall be given a grade of 1/4-inch per foot unless specifically indicated otherwise on the Plans.

152611 FITTINGS

Changes in pipe size on soil and waste lines shall be made with reducing fittings. All changes in direction shall be made by use of 45-degree wyes, half wyes, long sweep 1/4 bends, 1/6, 1/8, or 1/16 bends, except that sanitary tees may be used on vertical stacks; and short 1/4 bends or elbows 3 inches in size or larger may be used on soil or waste lines where the change in direction of flow is from horizontal to vertical and on the discharge from water closets.

152612 UNION CONNECTIONS

Slip joints will be permitted only in trap seals or on the inlet side of the traps. The use of long screws and bushings is not acceptable.

152613 JOINTS

Bell-and-spigot joints shall be firmly packed with oakum and caulked with not less than 1 inch of lead or shall be made up with double seal elastomer push-on gaskets. Threaded joints shall be American Standard Taper screw threads, clean cut, and made up with graphite and oil or other suitable pipe compounds.

152614 CLEANOUTS

Cleanouts shall be the same size as the pipe, except that cleanout plugs larger than 4 inches will not be required. Each lavatory waste line shall be provided with a test tee cleanout with opening in the side through the wall with chrome plated wall plate and screw, Zurn No. Z-1460-9, Josam 8750, or equal. Cleanouts in floors or walls in basement areas shall have cast iron ferrule with counter-sunk brass plug flush with the surface of the floor or wall. Cleanouts in floors in ground floor areas shall have cast iron ferrule with raised head brass plug under chrome-plated brass access cover and frame, Zurn No. Z-1343-2, Josam 8140, or equal. Cleanouts in walls in ground floor areas shall have raised head brass plug with chrome-plated wall plate and screw, Zurn No. Z-1460-9, Josam 8600, or equal.

152617 DRAINAGE

Floor drainage system shall be furnished and installed as indicated on the Plans. Floor drain piping shall be extra-heavy cast iron soil pipe with extra-heavy cast iron soil pipe fittings or ABS pipe and fittings.

152618 EQUIPMENT AND FLOOR DRAINS

Equipment drains shall be Zurn Z-415E, Josam 300-E2 combination drip drain, less clamping collar, or equal, with adjustable strainer head, floor level grate, and 6-inch diameter funnel extension and shall have inside caulking outlet and nickel bronze top. All other floor drains shall be Zurn Z-415E, Josam 30000A universal floor drain with adjustable strainer, less clamping collar, or equal, and shall have inside caulking outlet and nickel bronze Type A strainer. Sizes of equipment drains and of floor drains shall be as indicated on the Plans. Strainers with 3-inch drains shall be 6-inch diameter, and strainers with 4-inch drains shall be 8-inch diameter.

152623 ESCUTCHEONS

Chrome-plated escutcheons shall be provided around all exposed waterlines, drains, and vents where they pass through walls, floors, or ceilings.

Where any pipe passes through a metal deck ceiling, a metal escutcheon suitable for painting shall be provided.

All escutcheons shall be held in place by a set screw or other approved means.

153000 VALVES

The Contractor shall furnish all valves where indicated on the Plans, as called for in these Specifications, or as required for proper operation of the equipment in general. Unless otherwise indicated on the Plans or specified in other sections of these Specifications, valves shall conform to the requirements as specified herein.

Valves shall be manufactured by a manufacturer whose valves have had successful operational experience in comparable service.

The valve manufacturer shall furnish detailed technical information as required by the Engineer for evaluating the quality of the valves and as required by the Contractor for proper valve installation. The technical information shall include complete dimensions, weights, and material lists. No valve will be approved for installation until the required information has been received and approved.

The Contractor shall furnish three sets of complete installation operation and maintenance instructions for each type of valve furnished. Instructions shall be bound in a cover.

Wherever stainless steel is specified in this section, it shall be ANSI Type 316, or Type 304 unless otherwise specified.

Where valve, gate, and operator bolts and nuts are submerged in sewage or water, occur in an enclosed space above sewage or water, are installed below the tops of walls of structures containing sewage or water and are installed at openings in concrete or metal decks, bolts and nuts shall be stainless steel unless specifically noted otherwise. Where dissimilar metals are being bolted, stainless steel bolts shall be used. Underground bolts shall be low-alloy steel in accordance with AWWA C 111, unless specifically noted to be otherwise.

The zinc content of bronze or brass used in any valve parts shall not exceed 6 percent. The aluminum content of bronze shall not exceed 2 percent.

The method of connection of valves to each piping system shall be as detailed on the Plans. In general, unless otherwise indicated on the Plans or specified, all valves 3-inch size and larger shall have flanged ends or shall be designed for bolting to flanged pipe, and all valves less than 3-inch size shall have screwed ends.

The Contractor shall furnish to the pipe supplier, after flanged valves and flanged check valves are selected, the face-to-face dimensions of all flanged valves and check valves to be installed in flanged pipelines so that the pipe may be fabricated to the proper length.

All buried valves shall have cast iron valve boxes. The boxes shall be asphalt varnished, or enameled cast iron, adjustable to grade, and installed perpendicularly, centered around and covering the upper portions of the valve or valve operator. The box shall not be supported in any manner by the valve, valve operator, or the pipe. The top of each valve box shall be placed flush with finish grade unless otherwise directed by the Engineer. Valve boxes shall be 564 A by, Tyler Pipe Industries Inc.; or equal.

All buried valves and other valves located below the operating deck or level, specified or noted to be key operated, shall have an operator shaft extension from the valve or valve operator to finish grade or deck level, a 2-inch square AWWA operating nut, and cover or box and cover, as may be required.

Except as otherwise specified, all buried valves shall be painted with two coats of asphalt varnish in accordance with the requirements of AWWA Standard C 500. This protective coating shall be protected from damage until valve is backfilled. After installation the valves shall be wrapped with polyethylene as specified for cast iron pipe.

Globe and gate valves shall be installed with stems horizontal or vertical above the pipe, except as specifically indicated otherwise.

All butterfly valves and plug valves above grade not specified to have geared operators shall be fitted with ell or tee wrench or handles for operation. Wrenches shall be secured to the valve head or stem except that if a wrench so secured constitutes a hazard to personnel it shall be stowed immediately adjacent to the valve on or in a suitable hanger, bracket, or receptacle.

Where proper operation and utilization of equipment and facilities requires installation of valves not shown or specified, the Contractor shall provide and install, upon approval by the Engineer, valves similar and comparable to valves specified for similar and comparable duty in other parts of the project, without additional cost to the Owner.

153010 INSTALLATION OF VALVES

The Contractor shall furnish all labor, materials, and equipment necessary to install the valves complete in place at the locations indicated on the Plans in accordance with the details and these Specifications.

The Contractor shall furnish all incidental materials necessary for installation of the valves such as flange gaskets, flange bolts and nuts, valve boxes and covers, and all other materials required for the complete installation.

The Contractor shall provide the necessary concrete bases and blocking to support the valves.

Manually operated valves and gates located not more than 6 feet above the operating level shall be provided with tee handles, wrenches, or handwheels as is appropriate. Valves over 5 feet to center line shall be rolled toward the operating side to make the handwheel or wrench more accessible to the operator of average height. Valves located below the operating level or deck shall be provided with extensions for key operation or floor stands and handwheels as appropriate. Valves over 6 feet above the operating level shall be fitted with chain operated handles or valve wheels as appropriate. Chains shall reach to approximately 4 feet above the operating level. If, when not in use, chains constitute a nuisance or hazard to operating personnel, they shall be provided with hold backs or other means of keeping them out of the way. Valves shall be installed in all cases so that handles clear all obstructions when moved from full-open to full-closed position.

153100 BUTTERFLY VALVES

Butterfly valves and operators shall conform to AWWA Standard for Rubber-Seated Butterfly Valves, AWWA C 504, except as modified or supplemented herein.

Butterfly valves may be short body or long body at the option of the Contractor and as determined by their location in the pipe system. Wafer valves may be used at some locations subject to each location being approved by the Engineer. Wafer butterfly valves shall not be used as an isolation valve where equipment and/or piping may be required to be removed from one side of the valve. Wafer valves may be used only between pipe flanges and in locations where the opening of the valve disc will not interfere with adjacent piping, fittings, check valves, and other equipment. Short body valves may be used only in locations where the disc will not interfere with adjacent pipe fittings, valves, or equipment.

Valves and operators shall be designed for a flow through the valve corresponding to a pipeline velocity of 16 feet per second with the vane in the position of maximum coefficient of torque or for the maximum torque that may occur under the specified operating conditions of flow, pressure, valve angle, including seating, unseating, and bearing torque, with the safety factors as required in AWWA C 504 standards and as recommended in Table 2A, Appendix A, of AWWA C 504, whichever is greater.

Records of tests shall be furnished as specified in AWWA C 504. Valve discs for valves on liquid service shall be stainless steel disc to 12 inches and stainless-steel disc or stainless steel mating edge on ni-resist cast iron or cast iron disc above 12 inches. Method of attaching edge to disc shall be subject to approval by the Engineer.

The valve shaft, keys, dowel pins, or taper pins used for attaching the valve shaft to the valve disc shall be Type 304 or Type 316 stainless steel or equivalent corrosion resistant material. All portions of the shaft bearings shall be stainless steel, bronze, nylon, or fiberglass and Teflon in accordance with AWWA C 504.

All nuts and screws used with clamps and discs for rubber seats shall be securely held from loosening from vibration or cavitation effects.

Valve disc shall seat in a position of 90 degrees to the pipe axis and shall rotate 90 degrees between full open and tight closed position.

Valves shall be installed with valve shafts horizontal.

Butterfly valves above ground shall be provided with 150 lb or 250 lb flanges, as indicated on the plans, and buried valves shall be mechanical joint of suitable pressure rating. Maximum shutoff pressure shall be 200 psi.

Manual operators for valves less than 2-inch diameter shall be the hand lever type. All hand lever operators shall be provided with a locking device so that the valve can be locked in any position with a wing nut. The locking device shall be rigid and shall not allow any vibration or chattering of the valve. The hand lever shall be 12 inches long and shall be provided with a rubber hand grip.

Valves larger than 6 inches that are buried in the ground shall be provided with a totally enclosed worm gear operator mounted on the valve. The valve shaft shall extend from the valve to the operator and shall be as specified for valve shafts. The operator shall be gasketed for watertightness. Operators shall be

suitable for buried service and shall have an operator shaft extension to finished grade, a 2-inch square AWWA nut, valve box, and cover.

Manual operators on aboveground butterfly valves larger than 6 inches shall be geared operators except that valves 10 inches and smaller on low pressure air service may be lever operated.

Manual and motorized operators shall comply with the requirements of paragraphs 154500 through 154600 as applicable to the required installation indicated on the Plans.

Protective coatings shall be as specified in Section 15 of AWWA C 504.

Butterfly valves shall be Lineal III as manufactured by Mueller Company, with no equal. Valve boxes shall be Tyler 564 A cast iron valve boxes with no equal.

153200 GATE VALVES ABOVEGROUND

Gate valves under 3 inches in size for clear water and air service shall be bronze, double disc, rising stem, screwed end valves Lunkenheimer Figure 2125, Jenkins Figure 62, or equal. Gate valves 3 inches in size and larger shall be flanged 200-pound iron body, bronze mounted, OS&Y double disc, parallel seat Mueller A-2483-6, with stems of silicon bronze conforming to ASTM B 98, Alloy No. 661, or equal. Each valve shall be furnished with handwheel and shall open counterclockwise. Valves shall be suitable for 250 psi. Gate Valves shall be Mueller Resilient Seat Valves, with no equal.

153210 GATE VALVES UNDERGROUND

Gate valves for buried installation shall be iron body, resilient seat, nonrising stem, conforming to AWWA C 509, with double O-ring stem seal and epoxy coated in conformance with AWWA C550. Valves shall open counterclockwise. Valve ends shall be flanged or mechanical joint as required for the type of pipe used. Maximum shutoff pressure shall be 200 psi. Operators shall be suitable for buried service and shall have an operator shaft extension to finished grade, a 2-inch square AWWA nut, valve box, and cover. Gate Valves shall be Mueller Resilient Seat Valves, with no equal. Valve boxes shall be Tyler 564 A cast iron valve boxes with no equal.

153400 CHECK VALVES

Except as otherwise specified, shown on the Plans, or approved by the Engineer, check valves shall be as follows: Check valves shall be for 150-pound or better service and suitable for operation in either horizontal or vertical position.

153410 SLANTING DISC CHECK VALVES

Where shown on the Plans, the Contractor shall furnish and install slanting disc check valves that begin to close as the forward flow diminishes and is fully closed at zero velocity, preventing flow reversal. The valve shall be designed for a working pressure of 170 psi. The seat and disc ring must be hand replaceable in the field without removing the valve from its installation or without machining. The valve shall be incorporate drop tight seating design and shall have an integral disc position indicator.

The body shall be cast iron. The seat and disc shall be bronze in accordance with ASTM B584. A Buna-N seal shall be furnished to provide zero leakage. Valves shall be epoxy lined and coated in conformance with AWWA C550. The leakage rate shall not exceed one-tenth the allowable rate allowed by the

AWWAC508-82. The check valve needs to be provided bottom side dashpots to eliminate surges and dampen hydraulic pressure waves. The dashpot shall be field adjustable.

The head loss thru the valve shall not exceed the values specified below:

12-inch check valve: 2-ft head loss @ 6,000 gallons per minute

The valves shall be APCO series 800 BMB, Valmatic Tilted Disc, or approved equal.

153413 PRESSURE REDUCING/SURGE ANTICIPATING VALVE

Where shown on the Plans, the Contractor shall furnish and install pressure reducing/surge anticipating valve. The valve shall be a hydraulically operated, single diaphragm-actuated and globe or angle pattern. The valve shall consist of three major components: the body with seat installed, the cover with bearings installed and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the main valve or pilot controls.

No separate chambers shall be allowed between the main valve cover and body. Valve body and cover shall be of cast material. Ductile Iron ASTM A536 is standard. No fabrication or welding shall be used in the manufacturing process.

The valve shall contain a resilient, synthetic rubber disc, with a rectangular cross-section contained on three and one-half sides by a disc retainer, forming a tight seal against a single removable seat insert. No O-ring type disc (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing shocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hourglass-shaped disc retainers shall be permitted and no V-type or slotted type disc guides shall be used.

The diaphragm assembly containing a non-magnetic 303 stainless steel stem of sufficient diameter to withstand high hydraulic pressures, shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. The seat shall be a solid, one-piece design and shall have a minimum of a five-degree taper on the seating surface for a positive, drip-tight shut off. No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve separating operating pressure from line pressure.

The diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Burst Test of a minimum of 600 psi per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully open or fully closed position.

The main valve seat and the stem bearing in the valve cover shall be removable. The cover bearing and seat in 6" and smaller size valves shall be threaded into the cover and body. The valve seat in 8" and

larger size valves shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To ensure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No “pinned” covers to the valve body shall be permitted. Cover bearing, disc retainer, and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. Packing glands and/or stuffing boxes shall not be permitted.

The valve shall be closed when line pressure is between the set-points of the two pilots. The valve shall open initially when line pressure drops below the setting of the low-pressure pilot to anticipate surges associated with a pump stopping. The valve shall also continue to react and remain open when the return high-pressure wave is above the setting of the high-pressure pilot or will open when inlet pressure exceeds a pre-determined set-point at which time the valve opens quickly.

The valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of three years from date of shipment provided the valve is installed and used in accordance with all applicable instructions. Electrical components shall have a one-year warranty.

The valve manufacturer shall be able to supply a complete line of equipment from 2 1/2” through 24” sizes and a complete selection of complementary equipment. The valve manufacturer shall also provide a computerized cavitation chart which shows flow rate, differential pressure, percentage of valve opening, Cv factor, system velocity, and if there will be cavitation damage.

The pressure relief pilot shall be an adjustable, spring-loaded, normally closed diaphragm control designed to permit flow when upstream pressure exceeds the control setting. The low pressure pilot shall be an adjustable, spring loaded, normally open diaphragm control designed to open when the sensed pressure falls below the control setting and close when pressures are normal. The pilot system shall contain an adjustable hydraulic limiter to limit valve travel during low pressure opening without affecting high pressure relief valve travel. The contractor shall connect the sensing/pilot supply connection to the main header with minimum 3/4” pipe or tubing. A full range of spring settings shall be available in ranges from 0-450 psi.

The valve shall be a Cla-ValCo. Model No. 52-03/652-03 Pressure Relief/Surge Anticipator Valve or approved equal.

153415 PRESSURE REDUCING VALVE

Pressure reducing valves shall be provided and installed at locations as indicated on the Plans. Valves shall be set for a low flow and a high flow set point. The valves shall be provided with an adjustable flow pilot set point. When the flow set point is reached, the second valve will open to allow the flows to be met. When the flow returns below the pilot set point, the valve shall then close slowly without generating a pressure surge. The valves shall in summary shall act as a standard low flow and high flow pressure reducing valve.

The valve shall have a position limit switch (dry contact) that will provide a signal when the valve is open.

153415.1 VALVE OPERATION CONDITIONS

153415.2 VALVE OPERATION

- A. Valve shall be capable of both manual and automatic opening and closing.
- B. The valve pressure sustaining set point shall be approximately 45 psi.

153415.4 VALVE CONSTRUCTION

- A. Valve shall be Globe style straight through configuration.
- B. The valve shall have only one flanged cover at the valve top from which all internal parts shall be accessible. There shall be no stems, stem guides or spokes within the waterway.
- C. Valve body and cover shall be ASTM A536 Ductile Iron.
- D. Valve flanges shall be 250 lb. ANSI B16.42.
- E. Valve disc retainer and diaphragm washer shall be Cast Iron.
- F. Valve trim shall be Bronze B-62.
- G. Valve disc shall be Buna-N Rubber.
- H. Valve diaphragm shall be Nylon Reinforced Buna-N Rubber.
- I. Valve stem, nut, and spring shall be Stainless Steel.
- J. Valve shall be supplied completely piped ready for installation.

153415.5 PILOT SYSTEM

- A. Pilot operation for automatic and manual opening and closing the valve.
- B. Pilot control shall be Bronze ASTM B62.
- C. Trim shall be Stainless Steel Type 303.
- D. Rubber shall be Buna-N Synthetic Rubber.
- E. Tubing & fittings shall be Copper and Bronze.

153415.6 TRAINING

The valve supplier shall include as a minimum 4 hours of start-up, training and assistance by trained personnel.

153415.7 MANUFACTURER

The valve shall be CLA-VAL Pressure Reducing Valve Model 90-01/690-01 or equal.

153416 FLOW CONTROL VALVE

Where shown on the Plans, the Contractor shall furnish and install a flow control valve

DESIGN

- A. The plunger valve shall be a horizontal in-line, flow through design where one central piston controls the flow of the media. The flow through design allows for debris and other small particles to pass through the valve without having a negative effect. The internal cone is designed to divert the water flow into the annular chamber of the body section. The resilient seating surface must be aligned to be out of the flow path to prevent damage to the seating surface. The valve body shall be a one-part body.
- B. Plunger valves shall be rated for working pressures of no less than 250 PSI and shall provide zero leakage at full rated pressure.
- C. Valve shall be supplied with integral class 125 or 250 flanges.

- D. The valve size, pressure rating, year of manufacture and manufacturer's name & model shall be cast onto the valve body or be on a permanently attached nameplate.
- E. Flow: The plunger shall move in an axially flow direction to reduce or enlarge the annular flow cross-section through slots in a degressive manner, and the medium will flow through the customized regulating cylinder from the outer annular chamber to the inner chamber of the plunger, for flow control.
- F. Each valve shall be supplied with a factory inspection certificate outlining body pressure test, leakage test, valve size, valve serial number, pressure rating, body heat No., stem heat No. seat material and seat heat No.

MATERIALS

- A. Body: Valve bodies shall be ductile iron, ASTM A536 65-45-12 or A536 60-40-18, with ANSI B16.1s. Pre drilled lifting holes lugs shall integrally be provided to assist in the installation and removal of valve from the pipeline.
- B. Regulating Parts: The plunger shall be 304 Stainless Steel, the cavitation cage shall be 304 SST, the push rod and piston rod shall be 304 stainless steel.
- C. Shaft: The Shaft shall be 304 SST.
- D. Sealing: All resilient seals shall be EPDM and the main shaft seal must be out of the flow path to prevent damage when valve is in operation.
- E. Piston Guide Rails: The plunger shall slide and be contained in the axial position by guide rails. To prevent possible corrosion between the guide rails and the valve body, the guide rails shall be completely fused to the valve body in an overlay weld process to prevent any gaps or corrosion pathways. Guide rails which are riveted or bolted to the valve body are not acceptable for long-term operability and corrosion protection. The guide rails shall be bronze and shall be positioned around the plunger in an uneven quantity to reduce the potential for damaging harmonic vibration, clogging or excessive wear. The guide rails shall be low to no lead and very low zinc content to prevent dezincification.
- F. Shaft Bearings: Valve shaft bearings shall be corrosion resistant, self-lubricating sleeve type made of bronze. Non-metallic shaft bearings are not allowed.
- G. The iron surfaces of the valve body and disc shall be coated with minimum 12 mil DFT fusion bonded epoxy

or two part epoxy

ACTUATION

- A. Manual Actuators: Actuators shall conform to ANSI/AWWA C540, subject to the following requirements. All actuators shall be self-locking worm gear type and shall hold the valve piston in the closed, open and

any intermediate position without creeping or fluttering and be supplied from known and reputable gear manufacture.

MANUFACTURER

- A. Manufacture shall be ISO 9001:2008, Accredited and Certified.
- B. Manufacture shall have current NSF 61/372 Certifications
- C. Manufacture shall have valve performance independently tested and verified in the USA by an accredited third party flow testing facility.
- D. Valve shall be the VRX Plunger Valve, AV-TeK® Valve USA

The valve shall be actuated based on electronic signals from a separate flow meter and shall open or close to match the determined set point

The valve shall have a position limit switch (dry contact) that will provide a signal when the valve is open.

153416.1 VALVE OPERATION CONDITIONS

153416.2 VALVE OPERATION

- A. Valve shall be capable of both manual and automatic opening and closing.

153416.5 PILOT SYSTEM

- A. Pilot operation for automatic and manual opening and closing the valve.
- B. Pilot control shall be Bronze ASTM B62.
- C. Trim shall be Stainless Steel Type 303.
- D. Rubber shall be Buna-N Synthetic Rubber.
- E. Tubing & fittings shall be Copper and Bronze.

153416.6 TRAINING

The valve supplier shall include as a minimum 4 hours of start-up, training and assistance by trained personnel.

153416.7 MANUFACTURER

The valve shall be a 10" VRX Plunger advanced control valve with orifice cage with no equal.

153500 BALL VALVES

Where shown on the Plans, the Contractor shall furnish and install ball valves of the type and material shown or specified. Except as otherwise specified, all ball valves shall have TFE seats and TFE or Viton stem seals. Valves shall be suitable for working pressure not less than 250 psi. Stem packing shall be manually adjustable while valve is under pressure. Valves shall be non-lubricated, and capable of sealing in either flow direction.

153520 PLASTIC BODY BALL VALVES

Except as otherwise specified, plastic body ball valves shall be PVC body Celanese Piping Systems, Inc. "Chemtrol;" Hill-McCanna "McCannaplast;" or equal. The valves shall be furnished with wrench type operator handles, and shall have union type end connections. All PVC ball valves shall be true union unless approved otherwise.

153710 PLAIN HOSE VALVES

Hose valves not otherwise designated shall be Jenkins Figure No. 112, Crane No. 58, or equal, angle hose valves. For yard hydrants they shall be mounted on 1-inch IPS risers with concrete splash blocks as detailed on the Plans. Each valve shall be provided with a nozzle type vacuum breaker.

153843 COMBINATION AIR VALVE-AND-VACUUM VALVE

Air and vacuum valves shall be designed to allow large quantities of air to escape out of the orifice when filling a pipeline and to close water tight when the liquid enters the valve. The air and vacuum shall also permit large quantities of air to enter through the orifice when the pipeline is being drained to break the

vacuum. The discharge orifice area shall be equal or greater than the inlet of the valve. The valve shall consist of a body, cover, baffle, float and seat. The baffle will be designed to protect the float from direct contact of the rushing air and water to prevent the float from closing prematurely in the valve. The seat shall be fastened into the valve cover without distortion and shall be easily removed if necessary. The float shall be stainless steel designed to withstand 1000 psi or more. The float shall be center guided for positive seating.

The valve shall be in all respects similar to APCO Models as follows or approved equal.

<u>Location</u>	<u>Valve</u>
30" Discharge Header	2-inch, Model AVC
30" Central Zone Connection	2-inch, Model AVC
12" Surge Anticipating Pipe	4-inch, Model AVV 150

The valves must be painted with three or more coats of epoxy rated for culinary water service for resistance to corrosion.

All materials of construction shall be certified in writing to conform to A.S.T.M. specifications as follows:

Body, Cover and Baffle	Cast Iron	ASTM A126 Class B
Float	Stainless Steel	ASTM A240
Seat	Buna-N	

153417 Swing Check Valve

152417.1 Series 7800

SCOPE

- 1.1 This specification covers the design, manufacture, and testing of 2 in. (50 mm) through 48 in. (1200 mm) Swing Check Valves suitable for cold working pressures of 250 psig.
- 1.2 The check valve shall be of the full flow body type, with a domed access cover and vent port.
- 1.3 The check valve shall be capable of accepting air cushion, lever and weight or lever and spring.

STANDARDS AND APPROVALS

- 2.1 The valves shall be designed, manufactured and tested in accordance with American Water Works Association Standard ANSI/AWWA C508 and in accordance with Manufacturers Standardization Society Standard Practice MSS SP-71 or MSS SP-136.
- 2.2 The valves used in potable water service shall be certified to NSF/ANSI 61, Drinking Water System Components – Health Effects, and certified to be Lead-Free in accordance with NSF/ANSI 372.
- 2.3 Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

CONNECTIONS

- 3.1 The Valves shall be provided with flanges drilled in accordance with ASME B16.1, Class 125 iron flanges or ASME B16.42, Class 150 for ductile iron flanges.

DESIGN

- 4.1 The valve body shall be full flow equal to nominal pipe diameter at all points through the valve and shall be equipped with a threaded adjustable open stop. The body seat shall be O-ring sealed and field replaceable without removing the valve from the line. The end flanges shall contain integrally cast mounting pads.
- 4.2 The top access port shall be full size, allowing removal of the disc without removing the valve from the line. The access cover shall be domed in shape to provide flushing action over the disc for operating in lines containing high solids content.
- 4.3 The disc shall be of one-piece construction and connected to the shaft with a disc arm and two pivot pins to provide pivot action to allow self-adjusting seating at all pressures. 14" and larger discs shall be convex shape for lift, stabilization and strength.
- 4.4 When specified, the disc seat shall be resilient with integral O-ring type sealing surface for drop tight shut-off at high and low pressures and for easy replacement in the field without removing the valve from the line.
- 4.5 When specified, metal seated valves shall have aluminum bronze seats.
- 4.6 The shaft seals shall consist of V-type packing in a fixed gland with an adjustable follower designed to prevent over compression of the packing and to meet design parameters of the packing manufacturer. Removable, slotted shims shall be provided under the follower flanges to provide for adjustment and prevent over loading of the packing. When specified, the valve shall be factory equipped with a lever and weight assembly. The lever shall be equipped with three holes for adjusting the bolted weight assembly. When the valve is closed, the lever and weight shall be located 30 degrees below horizontal.
- 4.7 When specified, the valve shall be factory equipped with a lever and air cushion assembly mounted between the weight assembly and the valve body. The air cushion assembly shall consist of a clevis mounted tie-rod type closed cylinder with speed control valves.
- 4.8 When specified, the valve shall be factory equipped with a lever and spring assembly. The spring shall be mounted to a bracket on the side of the valve body with a bolt assembly to adjust the spring tension.

MATERIALS

- 5.1 The valve body, cover and disc shall be constructed of ASTM A536 Grade 65-45-12 ductile iron for sizes 2 in. (50 mm) through 24 in. (600 mm) and ASTM A126 class B, gray iron for sizes 30 in. (800mm) through 48 in. (1200mm), with optional body material ASTM A536 Grade 65-45-12 ductile iron.
- 5.2 The exterior and interior of the valve shall be coated with an NSF/ANSI 61 approved fusion bonded epoxy coating.
- 5.3 The removable body seat shall be constructed of ASTM A276, Type 304 stainless steel.
- 5.4 The removable resilient seat shall be precision molded Buna-N (NBR), ASTM D2000-BG. When specified, optional seat material includes EPDM.
- 5.5 The disc, arm, and external levers shall be ductile iron.

OPTIONS

- 6.1 A pre-wired limit switch shall be provided (when specified) to indicate open/closed position to a remote location. The mechanical type limit switch shall be activated by the external arm and rated for NEMA 4, 6, or 6P and shall have U.L. rated 5 amp, 125 or 250 VAC contacts.
- 6.2 When specified, the lever and weight assembly shall be enclosed within a removable safety guard constructed of perforated metal for visibility.

MANUFACTURE

- 7.1 Manufacturer shall demonstrate a minimum of five (5) years' experience in the manufacture of swing check valves.

- 7.2 All valves shall be hydrostatically and seat tested per AWWA C508 to demonstrate leakage criteria and structural integrity. When requested, the manufacturer shall provide test certificates, dimensional drawings, parts list drawings, and operation and maintenance manuals.
- 7.3 Swing Check Valves shall be Series 7800 (resilient seated) or 7800M (metal seated) and equipped with AC (air cushion), LW (lever and weight), or LS (lever and spring) as manufactured by Val-Matic® Valve & Mfg. Corporation, Elmhurst, IL USA or approved equal.

152417.2 Series 7900

SCOPE

- 1.1 This specification covers the design, manufacture, and testing of 8 in. (200 mm) through 48 in. (1200 mm) Swing Check Valves suitable for water and wastewater service.
- 1.2 The Cold Working Pressure rating of the valves shall be 200 psig for 8 in. (200 mm) to 12 in. (300 mm) sizes and 150 psig for 14 in. (350 mm) and larger.
- 1.3 The Swing Check Valve shall be of the full waterway body type, with a drain port and domed access cover with vent port.
- 1.4 A Bottom Oil Cushion with Lever and Weight shall be provided on sizes 8 in. (200 mm) to 48 in. (1200 mm) when specified.
- 1.5 A 2-Stage or 3-Stage Side Oil Cushion and Lever and Weight shall be provided on sizes 8 in. (200 mm) to 24 in. (600 mm) when specified.

STANDARDS AND APPROVALS

- 2.1 The valves shall be designed, manufactured and tested in accordance with American Water Works Association Standard ANSI/AWWA C508 and in accordance with Manufacturers Standardization Society Standard Practice MSS SP-136.
- 2.2 The valves used in potable water service shall be certified to NSF/ANSI 61, Drinking Water System Components - Health Effects, and certified to be Lead-Free in accordance with NSF/ANSI 372.
- 2.3 Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

CONNECTIONS

- 3.1 The Valves shall be provided with flanges drilled in accordance with ASME B16.42, Class 150 for ductile iron flanges.

DESIGN

- 4.1 The valve body shall be full flow equal to nominal pipe diameter area at all points through the valve and shall be equipped with a threaded adjustable open stop. The body seat shall be O-ring sealed and field replaceable without removing the valve from the line.
- 4.2 The top access port shall be full size, allowing removal of the disc without removing the valve from the line. The access cover shall be domed in shape to provide flushing action over the disc for operating in lines containing high solids content.
- 4.3 The disc shall be of one-piece construction and connected to the shaft with a disc arm and two pivot pins to provide pivot action to allow self-adjusting seating at all pressures. Discs shall be convex shape for lift, stabilization and strength.
- 4.4 When side oil cushions are specified, the shaft and keys shall be sized to withstand the full differential pressure torque.
- 4.5 When specified, metal seated valves shall have aluminum bronze seats.
- 4.6 When specified, resilient seated valves shall have a disc seat of a resilient material with integral O-ring type sealing surface for drop tight shut-off at high and low pressures and for easy replacement in the field without removing the valve from the line.
- 4.7 The shaft seals shall be a replaceable lead free bronze O-ring cartridge type.
- 4.8 Valves shall be factory equipped with a lever and weight assembly. The lever shall be equipped with three holes for adjusting the bolted weight assembly. The 8 in. oil cushion valves shall have one weight and lever assembly; 14 in. and larger valves shall be factory equipped with two lever and weight assemblies. When the valve is closed, the lever and weight shall be located 30 degrees below horizontal.

provide hydraulic control of the final 10% of valve closure and reduce water hammer normally associated with rapid flow reversal conditions on pump shut down. The cushion shall consist of a high pressure hydraulic cylinder, adjustable external flow control valve, pressurized oil reservoir and piping designed to control the closing speed of the last 10% of travel in 1-5 seconds. A cushion spacer which connects the cylinder to the valve shall have an air gap to prevent hydraulic fluid from entering the valve and contaminating the water system. A snubber rod fitted with O-ring seals and rod wiper scrapers shall make contact with the lower portion of the disc during closure.

- 4.1 When specified on side oil cushion valves as 2- stage oil cushion, the control function is as follows: During closure, the oil cylinder controls the speed of closure. As the check valve closes, oil from the bottom port of the cylinder is controlled by the Flow Control valve, typically 5-30 seconds. During the last 10% of travel, the closure is controlled using the internal cushion adjustment, typically 1-3 seconds.
- 4.2 When specified on side oil cushion valves as 3- stage oil cushion, the control function is as follows: During closure, the oil cylinder controls the speed of closure in three stages. As the check valve closes, oil from the bottom port of the cylinder flows freely through the 2-way valve allowing the valve to close rapidly, typically 1 to 2 seconds. When the valve travels to the 50% closed position (adjustable), the 2-way valve closes. The oil now is controlled by the Flow Control Valve, typically 5-30 seconds. During the last 10% of travel, the closure is controlled using the internal cushion adjustment, typically 1-3 seconds.

MATERIALS

- 5.1 The valve body, cover and disc shall be constructed of ASTM A536 Grade 65-45-12 ductile iron.
- 5.2 The shaft shall be ASTM A276, T304 stainless steel for bottom oil cushion valves and ASTM A564 T630 H900 alloy stainless steel for side oil cushion valves.
- 5.3 The exterior and interior of the valve shall be coated with an NSF/ANSI 61 approved fusion bonded epoxy coating.
- 5.4 The removable body seat and integral metal disc seat shall be constructed of aluminum bronze C95400.
- 5.5 The optional resilient seated disc seat shall be precision molded Buna-N (NBR), ASTM D2000-BG. When specified, optional seat material includes EPDM.
- 5.6 The disc arm and external levers shall be ASTM A536 Grade 65-45-12 ductile iron.

MANUFACTURE

- 6.1 Manufacturer shall demonstrate a minimum of five (5) years' experience in the manufacture of swing check valves.
- 6.2 All valves shall be hydrostatically and seat tested per AWWA C508 to demonstrate zero leakage and structural integrity. When requested, the manufacturer shall provide test certificates, dimensional drawings, parts list drawings, and operation and maintenance manuals.
- 6.3 Swing Check Valves shall be Series 7900B and 7900S as manufactured by Val-Matic® Valve & Mfg. Corporation, Elmhurst, IL USA or approved equal.

154600 PIPE HANGERS AND SUPPORTS

The Plans do not, in all cases, show where or how pipe is supported; however, it is intended that all pipe and fittings shall be properly supported, suspended, or anchored as required to prevent sagging, overstressing, or longitudinal movement of certain piping, and to prevent thrusts or loads on or against pumps, meters, and other equipment. The pipe support manufacturers shall determine the proper support size where sizes have not been indicated on the Plans.

In addition to supports indicated on the Plans, exposed piping shall be supported at the base of all risers, at intervals not to exceed 3 feet on all horizontal runs of pipe 2 inches and smaller, and at intervals not to exceed 10 feet on all horizontal runs of pipe larger than 2 inches. Piping 4 inches and larger through fill, backfill, or disturbed ground shall be supported at intervals not to exceed 10 feet with supports as detailed on the Plans. Plastic pipe and tubing, copper pipe and tubing, and rubber hose and tubing shall be supported at close enough intervals to prevent noticeable sagging (in no case more than 2.5 feet for diameters of less than 1-1/2 inches and 5 feet for diameters of 1-1/2 inches and larger), or shall be carried in trays.

Plastic pipe, valves, and headers shall be securely anchored to prevent any apparent movement during operation of valves. Plastic pipe shall be anchored between expansion loops and/or direction changes to provide for uniform expansion.

Where concrete supports are used under piping, the supports shall be poured 1 inch low, then the next day or later, the pipe grouted in place with nonshrink grout. Nonshrink grout shall be used under floor flanges to give level bearing. Floor flanges shall be bolted to the floor with at least two bolts, or as shown on the Plans.

Hanger rods shall be sized in accordance with the manufacturer's recommendation, or as shown on the Plans.

Supports, clamps, clevises, brackets, or any devices bearing against copper pipe shall be copper plated, copper throughout, or insulated, except trays which shall be galvanized.

Special details are shown on the Plans for special supports for heavy pipe and specials. Such supports shall be of heavy or sturdy design to carry the loads imposed thereon.

No use shall be made of chains, plumbers' straps, wire, or other such devices for suspending, supporting, or clamping pipe of any size or type.

Brackets, supports, hangers, etc. shall be painted as specified in DIVISION 9.

Except as otherwise specified or approved, hangers and supports shall be as follows.

154610 ANCHOR BOLTS AND INSERTS

Anchor bolts and concrete anchors shall be in accordance with DIVISION 5.

Where shown on the Plans, continuous concrete inserts, Unistrut Series P3200, or Elcen "Speed Strut" Figure 1150 of the lengths shown or specified shall be furnished and installed. Where not otherwise shown or specified, inserts in concrete ceilings and beam soffits may be malleable iron inserts, Grinnell Figure 152 or 282; Bergen-Patterson Part 108; Unistrut Series P3200; or equal. Wall and side beam inserts shall be Unistrut Series P3200; Elcen "Speed Strut" Figure 1150, or equal.

Support members shall be Unistrut Series P-1000, Elcen "Speed Strut" Figure 600, or equal. Support members and brackets shall be painted in accordance with the requirements of DIVISION 9, prior to installation of pipe or trays.

Brackets shall be brackets of the model number as called for on the Plans, and made from Unistrut Series P-1000; Elcen "Speed Strut" Figure 600, or equal.

Channel inserts shall be installed in all pipe trenches and pipe galleries below grade even under buildings at not more than 5 feet on centers. Channel inserts shall be installed in ceilings where shown on the Plans at not more than 5 feet on centers. Both wall and ceiling inserts shall be placed so that they are staggered at the midpoint spacing of the opposite wall. Channel inserts shall extend to within 3 inches of top of walls. Vertical channel supports installed opposite inserts shall extend to same height as inserts.

Under no circumstances will the use of Slugin or similar anchors relying on the deformation of a lead alloy or similar element for their holding power be permitted.

With the Engineers written permission, powder driven studs may be used for the securing of conduit and small pipe to structural metal, but their use will not be permitted in concrete, masonry, and similar materials.

154620 SINGLE PIPE HANGERS AND SUPPORTS

Single pipe hangers for pipe over 6-inch shall be adjustable clevis hangers, Bergen-Patterson Part 100; Grinnell Figure 260; or equal.

Single pipe hangers for pipes 6-inch and smaller may be as specified above or may be solid or split malleable iron rings, Bergen-Patterson Part 233 or 240; Grinnell Figure 104 or 101; or equal.

Single rod hangers for steam pipe shall be malleable iron or steel yoke and roller hangers, Elcen Figure 14 or 14A; Grinnell Figure 174 or 181; or equal.

Double rod steam pipe hangers, shall be Elcen Figure 15; Grinnell Figure 171; or equal.

154621 WALL OR CEILING CLAMPS

Pipe fastened against walls or ceiling shall be spaced out from the surface to allow the make up of unions, fittings, etc. For pipe larger than 2-inch, supports shall be offset pipe clamps, Elcen Figure 44; Bergen-Patterson Part 179; or equal. For pipe 2-inch and smaller, supports may be as above, or may be Unistrut standoff pipe clamps.

154630 TRAPEZE HANGERS

Use shall be made of trapeze hangers where shown on the Plans or where several pipes are located at the same elevation in a horizontal plane. Unistrut sections, fittings, etc., or their equal, shall be as called for on the Plans.

154640 WALL BRACKETS

Wall brackets shall be fabricated steel, Bergen-Patterson Part 84; Grinnell Figure 195; Unistrut P2513, 2513A, or 2542; or equal.

154660 FLOOR STANDS AND STANCHIONS

Floor stand or stanchion saddles shall be furnished with U-bolt hold down yokes, Grinnell Figure 259; Bergen-Patterson Figure 125; or equal.

Poured concrete pipe supports shall be cast where indicated on the Plans. Vertical corners shall be neatly chamfered. As a minimum of cradling, the concrete shall extend 1/4 of the pipe diameter above the pipe invert and at least 6 inches along the pipe shell.

154670 RISER SUPPORTS

All elbows to be supported from the floor shall be furnished and installed as base elbows, whether so indicated on the Plans or not. Supports for the base fittings shall be adjustable metal supports or concrete piers as shown on the Plans, or as directed by the Engineer.

Riser clamps shall be Elcen Figure 29, Grinnel Figure 261, or equal.

*** END OF DIVISION 15 ***

DIVISION 16

ELECTRICAL

160100 GENERAL

It is the intent of this part of the Contract Documents to cover all work and materials necessary for erecting complete, ready for continuous use, a tested and working electrical system, substantially as indicated on the Plans and as hereinafter specified. The work specified in this Division includes materials, testing, and installation of electrical system and equipment.

160101 GENERAL PROVISIONS

Minimum sizes of equipment, electric devices, etc., are indicated but it is not intended to show every offset and fitting, nor every structural or mechanical difficulty that will be encountered during the installation of the work.

All work indicated on the Plans is approximately to scale, but actual dimensions and detailed drawings should be followed as closely as field conditions permit. Field verification of scale dimensions on Plans is directed since actual locations, distances, levels, etc. will be governed by field conditions.

Discrepancies indicated on different Plans, between Plans and actual field conditions, or between Plans and Contract Documents shall be promptly brought to the attention of the Engineer for a decision.

The alignment of equipment and conduit shall be varied due to architectural changes, or to avoid work of other trades, without extra expense to the Owner.

The Contractor shall furnish and install all parts and pieces necessary to the installation of equipment in accordance with the best practice of the trade and in conformance with the requirements of these Contract Documents.

All items not specifically mentioned in these Contract Documents or noted on the Plans or accepted shop drawings, but which are obviously necessary to make a complete working installation, shall be deemed to be included herein.

Typical electrical details indicated on the Drawings shall apply to all locations whether or not they are specifically referenced on any drawings.

The Contractor shall lay out and install electrical conduit prior to placing floors and walls. He shall furnish and install all sleeves and openings through floors and walls required for passage of all conduits. Sleeves shall be rigidly supported and suitably packed or sealed to prevent ingress of wet concrete.

The Contractor shall furnish and install all inserts and hangers required to support conduits and other electrical equipment. If the inserts, hangers, sleeves, etc. are improperly placed or installed, the Contractor shall do all necessary work, at his own expense, to rectify the errors.

All electrical equipment shall be capable of operating successfully at full-rated load, without failure, at an ambient air temperature of 40 degrees C, and specifically rated for an altitude of 4350 feet.

The Contractor shall submit shop drawings, data and details to the Engineer on all controls, fixtures, wiring, electrical equipment, conduit, etc. for review and acceptance prior to use of any components in the work.

The Contractor shall provide for delivery, unloading, transportation and storage of all equipment under this Contract until such time as installation is required. To insure adequate protection of all electrical and instrumentation equipment and panels, all such equipment shall be stored in a suitable, air conditioned enclosure designed to protect this equipment from temperatures above 90 degrees F. The Owner shall assume no liability for either the storage facilities or equipment stored therein. The Contractor shall be responsible for maintaining the storage facilities and equipment stored therein and shall make provision for all utilities required. Continuous access shall be provided to the Owner for all equipment so stored.

160102 WORK INCLUDED

- A. Furnishing, installation, and connection of utility conduits.
- B. Furnishing, installation, connection and testing of a new motor control center.
- C. Installation of electrical control panels and equipment.
- D. Furnishing, installation, connections, and testing of control and power panels and equipment.
- E. Furnishing, installation, connection and testing of underground duct bank as indicated on the Plans.
- F. Electrical connections of all equipment furnished under this and other Divisions of the Contract, and requiring electric power and/or control.
- G. Installation of Owner furnished equipment including generator, automatic transfer switch, and metering switchboard.

160103 REGULATIONS AND CODES

Electrical work, including connection to electrical equipment integral with mechanical equipment, shall be performed in accordance with the latest published regulations of the National Electrical Code (NEC), National Electrical Safety Code (NESC), State and local codes, and according to the latest Institute of Electrical and Electronic Engineers (IEEE); American National Standards Institute (ANSI); American Society for Testing and Materials (ASTM); Insulated Cable Engineers Association (ICEA); National Electrical Manufacturers Association (NEMA) Standards; National Electrical Contractors Association (NECA) Standard of Installation; and the latest published regulations of the Federal Occupational Safety and Health Act (OSHA). When applicable, the material used in the performance of the electrical work shall be approved by the Underwriters' Laboratories, Inc. (UL) for the class of service for which they are intended.

160104 SEISMIC REQUIREMENTS

The Contractor is informed herein that all electrical equipment installed in this project shall be securely anchored, tied, restrained, or attached to the structures in such a manner that such equipment shall remain in place and function when subject to seismic forces. The Contractor shall be responsible for assuring the Owner that all subcontractors and suppliers furnish and install equipment and its anchorage in a manner

that shall conform to these requirements. Shop drawings for the following equipment shall be provided to show anchorage provisions which comply with these seismic requirements.

- A. MCC, low, medium voltage switchgear.
- B. Control panels and devices.
- C. Generator & automatic transfer switch

160105 TEMPORARY POWER

The Contractor shall furnish, install and maintain all temporary power and lighting systems needed for construction. This temporary system shall include weatherproof panel(s) for the Contractor's main breakers and distribution system. Ground fault interrupting equipment shall be installed. All connections shall be watertight with wiring done with Type SO portable cable. After construction is completed, the Contractor shall remove all temporary power equipment and devices.

160106 CUTTING AND REPAIRING

Where it becomes necessary to cut into existing concrete for the purpose of making electrical installations, core drills shall be used for making circular holes. Other demolition methods for cutting or removing shall be reviewed by the Engineer prior to starting the work.

The Contractor shall repair all damage caused thereby and restore damaged areas to original condition.

160107 CORROSION PROTECTION

Wherever dissimilar metals, except conduit and conduit fittings, come in contact, the Contractor shall isolate these metals as required with neoprene washers, 9-mil polyethylene tape, or gaskets. Where fastening conduit, electro plated, or equivalent fasteners and stainless steel bolts shall be used.

Factory finishes damaged and/or rusting shall be restored to original new condition.

All electrical panels, switchgear, motor control centers, etc. shall be shipped in sealed dust and moistureproof plastic sheet enclosures and the seal maintained until units are installed. Said units shall be in new condition, no dirt, dust, water, grease, rust, damaged parts, components, etc. All relay, starter, circuit breaker, switches, etc., contacts, insulators, mechanisms, and buses shall be free of dust, dirt, oil, moisture, metal shavings, etc. before testing and energizing.

All support channels, used in conjunction with the electrical work, shall be galvanized steel unless specifically specified or indicated on the drawings.

Once equipment is installed, it shall be protected at all times with plastic sheet covers until the area is secure from dirt, dust, workers, paint spray, water, etc. Heat shall be provided to eliminate condensation.

160108 COORDINATION OF THE ELECTRICAL EQUIPMENT RATING

The Contractor shall verify all actual equipment and motor full-load and locked-rotor current ratings. The necessary minimum equipment, wire, and conduit sizes are indicated on the Plans. If the Contractor furnishes equipment of different ratings, the Contractor shall coordinate the actual current rating of

equipment furnished with the branch circuit conductor size, the overcurrent protection, the controller size, the motor starter, and the branch circuit overcurrent protection. The branch circuit conductors shall have a carrying capacity of not less than 125 percent of the actual full-load current rating. The size of the branch circuit conductors shall be such that the voltage drop from the overcurrent protection devices up to the equipment shall not be greater than 2 percent when the equipment is running at full-load and rated voltage.

The motor running overcurrent protection devices shall be rated or selected to trip at no more than 125 percent of the motor full-load current rating for motors marked to have a temperature rise not over 40 degrees C or motors marked with a service factor not less than 1.15 and at no more than 115 percent for all other types of motors. The motor controller size shall be coordinated to the current rating and horsepower size of the installed motor.

The motor-branch-circuit overcurrent protection device shall withstand the locked-rotor current of the motor without tripping. This device shall also protect the motor-branch-circuit conductors and the motor control apparatus against overcurrent due to short-circuits or grounds. The motor control circuits shall have overcurrent protection of the type indicated on the Plans.

160109 TEST

The electrical work shall be free from improper grounds and from short circuits. The correctness of the wiring shall be verified first by visual comparison of the conductor connections with connection diagrams. Individual circuit continuity checks shall next be made by using electrical circuit testers. Last, the correctness of the wiring shall be verified by the actual electrical operation of the electrical and mechanical devices. Any deviation from the wiring indicated on the Plans or accepted drawings shall be corrected and indicated on the Record Drawings. The Contractor shall meter test all power and control wiring for all circuits and record results to ensure that actual tests are made and all circuits are free from improper grounds or shorts. The recorded results shall be submitted to the Owner as a record document.

Electrical tests shall be made on all medium voltage and low voltage equipment and shall consist of the following but not limited to:

- Low voltage motor control center and distribution equipment
- Switchgear, motor controls including all protective meters and relaying
- DC hypotential tests
- Switchgear ground and resistance to ground
- Medium and low voltage transformers

160110 CONFORMS TO RECORD DOCUMENTS DRAWINGS

Prior to completion of the Contract, the Contractor shall furnish the Engineer with a set of electrical plans marked with any changes, deviations or additions to any part of the electrical work.

Each conductor shall be identified as required by the Contract Documents. This identification shall be indicated on the record documents drawings to enable rapid and accurate circuit tracing by maintenance personnel.

160111 SINGLE LINE DIAGRAMS

Single line diagrams, as indicated on the Plans, show circuit voltages, (5xx is 4160V, 4xx is 480V, 3xx is 277V, 2xx is 208V, 1xx is 120V circuits), wire and conduit sizes, circuit protection rating, and other pertinent data. Where conflicts exist on the Plans the single line diagrams shall take precedence. Grounding conductors are not necessarily indicated. See grounding requirements specified elsewhere herein.

160112 CIRCUIT IDENTIFICATION

The 3-phase wires shall be identified at the switchgear, panelboards and motor control centers as Phases A, B, and C.

Color coding of general purpose conductor and cable should be in accordance with the following:

<u>Application</u>	<u>Conductors</u>	<u>Color</u>
3 Phase, 12,470 V	Phase A	3 black strips
	Phase B	3 red strips
	Phase C	3 blue strips
3 Phase, 5 KV Power (4,160 V)	Phase A	2 black strips
	Phase B	2 red strips
	Phase C	2 blue strips
3 Phase, 480 V, 208 Y/120 V Power or 240 V	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow
	Neutral	White
Control	All	Violet
All Systems	Neutral	White or Gray
	Ground	Green

In addition to color coding all conductors, each conductor shall be identified in each pull box, manhole, panelboard, cable tray, or termination with circuit identification markers. This identification is applicable to all power, control, alarm, and instrumentation conductors and these markings shall be recorded on the Record Documents. Markers shall be slip-on PVC sleeve type as manufactured by Brady, Seaton, or equal.

Markers for other cabling shall be B-292 vinyl as manufactured by Brady, Seaton, or equal.

160113 NAMEPLATES

The Contractor shall furnish and install nameplates which shall be black laminoid with white letters. The nameplates shall be fastened to the various devices with round head stainless steel screws. Each disconnect means for service, feeder, branch, or equipment conductors shall have nameplates indicating its purpose. All field mounted devices, transmitters, instruments, control stations etc. shall have identification nameplates.

All motor control centers, switchgear, control panels, light switches, enclosures and pull boxes shall have nameplates which shall consist of equipment name, function and applicable circuit designation.

160114 AUTOMATIC EQUIPMENT WARNING SIGNS

Permanent warning signs shall be mounted at all mechanical equipment which may be started automatically or from remote locations. Signs shall be in accordance with OSHA regulations and shall be suitable for exterior use. The warning signs shall be fastened with round head stainless steel screws or bolts, located and mounted in a manner acceptable to the Engineer.

Warning signs shall be 10 inches high by 14 inches wide, colored yellow and black, on not less than 18 gauge vitreous enameling steel. Sign shall read:

DANGER
THIS EQUIPMENT STARTS
AUTOMATICALLY
BY REMOTE CONTROL

160115 HIGH VOLTAGE WARNING SIGNS

Permanent and conspicuous warning signs shall be mounted on all equipment, doorways to equipment rooms, pull boxes, manholes, where the voltage exceeds 600 volts.

Signs shall be in accordance with OSHA regulation, and shall be suitable for exterior use. The warning signals shall be fastened with round head brass screws or bolts, located and mounted in a manner acceptable to the Engineer.

Signs shall be 10 inches high by 14 inches wide, colored red and white, on not less than 18 gauge vitreous enameling steel. Sign shall read:

DANGER
HIGH VOLTAGE
KEEP OUT

Exposed medium voltage circuit raceways shall be labeled at 50 foot intervals with 7 inch letters stating voltage. For example: 12,470 Volts - Labels shall be vinyl plastic made by Brady; Seaton; or equal.

160116 CONDUCTOR FASTENERS

Glue-on type conductor fasteners shall not be used in any panels, panelboards, switchboards, switchgear, motor control centers, or other enclosures containing electrical devices and/or conductors. Snap on or screw on type shall be used. Provide backplate for non glue-on type of fasteners.

160200 GENERAL MATERIALS AND METHODS

160201 GENERAL

All materials, equipment, and parts comprising any unit or part thereof specified or indicated on the Plans shall be new and unused, of current manufacture, and of highest grade consistent to the state of the art. Damaged materials, equipment and parts are not considered to be new and unused and will not be accepted.

Field verification of scale dimensions on Plans is directed since actual locations, distances, and levels will be governed by actual field conditions. The Contractor shall also review architectural, structural, yard, mechanical and other Plans, and the accepted electrical and mechanical shop drawings, and shall adjust his work to conform to all conditions indicated thereon.

160202 RACEWAYS

Raceways include rigid metal conduit, rigid nonmetallic conduit, or any other channel for holding wires, cables, or bus bars that is designed for, and used solely for, this purpose.

160202.10 CONDUIT

160202.11 GENERAL

All conduit shall be rigid steel unless specifically indicated otherwise on the Plans. All wiring, except as otherwise noted, shall be in conduit. Conduit size shall not be less than the National Electrical Code (NEC) size required for the conductors therein and shall not be smaller than 3/4-inch. No underground conduit shall be less than 1 inch.

Conduit runs are schematic only, and shall be modified as required to suit field conditions, subject to review and acceptance by the Engineer.

Conduit shall run continuously between outlets and shall be provided with junction boxes where connections are made, except in special pull boxes indicated on the Plans.

Conduits entering or exiting concrete shall be PVC coated or equivalent.

Conduit runs shall be straight and true; elbows, offsets, and bends shall be uniform and symmetrical. Changes in direction shall be made with long radius bends or with fittings of the conduit type. Conduit type fittings shall be Crouse-Hinds, Appleton, or equal with wedge nut covers.

Conduit runs in buildings and structures shall be exposed except as specifically noted or accepted by the Engineer.

Conduit runs shall not interfere with the proper and safe operation of equipment and shall not block or interfere with ingress or egress, including equipment removal hatches.

Exposed conduits shall be securely fastened with regulation clamps or straps. All exposed conduit shall be run on the walls and ceiling only and shall be parallel to the planes of the walls or ceiling. No diagonal runs will be permitted. Flexible conduit shall be used only for short lengths required to facilitate connections between rigid conduit and motors or control equipment. The maximum length of flexible conduit shall be 5 feet. Where flexible conduit is used, it shall be grounding type, weatherproof and watertight as manufactured by American Brass Company, General Electric, or equal. All conduits located outdoors or in wet locations shall be weathertight.

Conduit runs on water-bearing walls shall be supported 1 inch away from the wall on an accepted channel. When channel galvanizing or other coating is cut or otherwise damaged, it shall be field coated to original condition. No conduit shall be run in water-bearing walls, unless specifically designated otherwise.

Underground conduit runs shall be concrete encased, as detailed on the Plans, unless otherwise noted.

All conduit shall be thoroughly reamed after the threads have been cut to remove burrs. All joints shall be made with acceptable sealing compound and shall be watertight. Bushings or conduit fittings shall be used at all conduit terminals. The total of all bends in any run between pull boxes or junction boxes shall not exceed 360 degrees. Pull boxes shall be installed at points acceptable to the Engineer. Conduits

brought into pull boxes, conduits, and other openings shall be capped until used to prevent the entrance of moisture. All spare conduits shall be capped and shall contain a suitable plastic (non-corrosive) pulling wire.

Joints shall be set up tight. Hangers and fastenings shall be secure and of a type appropriate in design and dimensions for the particular application.

After installation of complete conduit runs 2 inches and larger, conduits shall be snaked with a conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85 percent of the nominal diameter of the conduit. Conduits through which the mandrel will not pass shall not be incorporated as part of the contract.

Conduit runs shall be cleaned and internally sized (obstruction tested) so that no foreign objects or obstructions remain in the conduit prior to pulling in conductors.

Couplings, connectors, and fittings shall be threaded and shall be certified types specifically designed and manufactured for the purpose. They shall be installed expertly to provide a firm mechanical assembly and electrical conductivity throughout.

All medium voltage underground conduit shall be PVC coated rigid galvanized steel.

Expansion fittings shall be installed across all expansion joints and at other locations where necessary to compensate for thermal expansion and contraction. Expansion fittings shall be OZ Type AX with jumper for exposed locations and Type DX at structural expansion joints, Spring City, or equal.

Shop drawings shall be submitted as requested by the Engineer for review and acceptance showing routing, conduit size, and number and size of wires in each conduit before installation of conduit.

160202.12 RIGID STEEL

Conduit and couplings shall be hot-dipped galvanized with zinc coated threads and outer coating of zinc bichromate as manufactured by Triangle PWC, Inc., Allied Tube and Conduit Corporation, or equal.

Steel conduit shall not be buried in earth without concrete encasement except in special cases where PVC coating is indicated on the Plans.

160202.14 PVC COATED STEEL

PVC coated conduit and fittings and associated pull boxes shall be installed where shown on the Plans or elsewhere specified and shall conform to NEMA RN-1, Current Edition.

The zinc surface of the conduit shall remain intact and undisturbed on both the inside and the outside of the conduit throughout the preparation and application processing. A Polyvinyl Chloride (PVC) coating shall be bonded to the galvanized outer surface of the conduit. The bond between the PVC coating and the conduit surface shall be greater than the tensile strength of the plastic. The thickness of the PVC coating shall be a minimum of 0.040 inch (40 mil).

A loose coupling shall be furnished with each length of conduit. A PVC coating shall be bonded to the outer surface of the coupling and a PVC sleeve equal to the outside diameter of the uncoated conduit shall extend beyond both ends of the coupling approximately one pipe diameter or 1-1/2 inches, whichever is

smaller. The wall thickness of the coating on the coupling and the sleeve shall be a minimum of 0.055-inch (55 mil).

A PVC coating shall be bonded to the outer surface of all conduit bodies and fittings and a PVC sleeve shall extend from all hubs. The wall thickness of the coating on conduit bodies and fittings and the sleeve walls shall be identical to those on couplings in length and thickness. The covers on all conduit bodies shall be coated on both sides and shall be designed to be completely interchangeable. The inside of conduit bodies shall remain undisturbed in the processing and shall retain the manufacturer's cadmium plate-aluminum paint finish.

Stainless steel screws shall be furnished and used to attach the cover to the conduit body. All coated material shall be installed and patched according to the manufacturer's recommended installation and patching instructions.

PVC coated conduit and fittings shall be as manufactured by Kor Kap Corporation, Occidental Coating Company, or equal.

160202.16 RIGID NONMETALLIC - PVC

Where specifically indicated on the Plans, or elsewhere specified, conduit may be high density Schedule 80, 90 degrees C, heavy-duty PVC. The conduit shall be manufactured from virgin polyvinyl chloride compound which meets ASTM standards. Smoke emissions shall be limited to less than 6 grams per 100 grams of material tested. Encasement shall be reinforced as indicated on the Plans. Conduit supports shall be installed at 2-1/2 foot intervals. PVC conduit shall be manufactured by Carlon, Triangle Conduit and Cable, or equal.

160202.20 CONDUIT SCHEDULE

Location	Conduit
Utility power conduits underground	PVC Sch 80
Utility power conduits exposed	Galvanized rigid steel
Conduits exposed in Pump Room	Galvanized rigid steel
Conduits entering concrete	Galvanized rigid steel Tape wrapped or PVC coated
Conduits in concrete	PVC Sch 40
Conduits below ground, not in duct bank	PVC Sch 80
Conduits below ground in concrete duct bank	PVC Sch 40

160202.30 METAL PULL BOXES

160202.31 GENERAL

Furnish and install pull boxes as indicated on the Plans and specified herein.

Installation of pull boxes shall be such that access to the pull boxes is not restricted by obstructions such as pipes, valves, ladders, etc. Exact locations and sizes shall be submitted to the Engineer for review and acceptance prior to fabrication and installation.

Additional pull boxes shall be installed as required to meet cable manufacturer's pulling tension requirements.

Covers shall be secured with 316 stainless steel screws or bolts with coated threads.

160202.32 CONSTRUCTION

Pull boxes shall be compatible with the type of conduit systems on which they are used. Pull boxes shall be fabricated from 11-gauge (minimum) steel or aluminum and shall be completely weatherproof with gasketed removable covers. Weatherproof conduit hubs shall be furnished for all conduit connections to pull boxes.

160202.33 FINISH

All metal surfaces shall be phosphatized and primed with a rust-resistant paint. Finish shall be two coats of "Safety Red" enamel paint.

160202.35 SIZING

Pull boxes shall be sized according to code and shall be sized to provide room for the future conduits and cables indicated on the Plans.

160203 CONDUCTORS

160203.01 GENERAL

All wiring shall be as indicated on the Plans. Wires shall be newly manufactured (not more than 12 months old) and shall be soft drawn copper with not less than 97 percent conductivity. The wire and cable shall have size, grade of insulation, voltage, and manufacturer's name permanently marked on the outer covering at not more than 2-foot intervals. All wires shall conform to the latest Standards of the ASTM and ICEA and shall be tested for their full length by these Standards. Insulation thickness shall be not less than that specified by the National Electrical Code.

Wire sizes shall be American Wire Gauge sizes with Class B stranded construction. No. 12 and No. 10 AWG may be solid conductor.

No. 2 AWG and smaller shall be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables shall be coded by the use of colored tape.

As far as practicable, all circuits shall be continuous from origin to termination without splices in intermediate pull boxes. Sufficient slack shall be left at the termination to make proper connections. In no case shall a splice be pulled into the conduit.

160203.02 PULLING LUBRICANT

All cables shall be properly coated with pulling compound recommended by the cable manufacturer before being pulled into conduits so as to prevent mechanical damage to the cables during installation.

Other lubricants to be substituted must be accompanied by a statement from the cable manufacturer as to its acceptable use with the cable being installed.

160203.20 600-VOLT CLASS CABLE

Individual or multiple conductor cables for power, control, and alarm circuits of 480 volts or less shall be insulated for not less than 600 volts and shall have Type THWN insulation. Cable tray conductors shall have Type TC insulation. Where wire size is not indicated, they shall be of the size required by the NEC, except that no wire external to panels and motor control centers shall be less than No. 12 AWG, unless specifically noted on the Plans. Panel control wiring shall not be less than No. 14 AWG. Wire and cable shall be as manufactured by Okonite Company, Anaconda Wire and Cable Company, or equal.

The pulling tension and side-wall pressures, as recommended by the cable manufacturer, shall not be exceeded.

160203.21 TERMINATIONS AND SPLICES (600-VOLT AND LESS)

Terminations shall be terminal board type with set-screw pressure connectors. Splicing shall join conductors mechanically and electrically to provide a complete circuit prior to installation of insulation. Conductors, including grounding conductors, of different sizes shall be spliced and then soldered or welded. Splices in wet locations and all splices below grade shall be waterproof heat shrink type as manufactured by Elastimold, Thomas-Betts, or equal.

160203.30 INSTRUMENTATION CLASS CABLE

Instrument cable shall have the number of twisted pairs indicated on the Plans and shall be insulated for not less than 600 volts. Unless otherwise indicated, conductor size shall be No. 18 AWG minimum.

The jacket shall be flame retardant Flamenal or Okoseal, 90 degrees C temperature rating. The cable shield shall be a minimum of 2.3-mil aluminum or copper tape overlapped to provide 100 percent coverage and a tinned copper drain wire.

The conductors shall be bare soft annealed copper, Class B, 7-strand minimum concentric lay with Okoseal or Vulkene, 15 mils nominal thickness, nylon jacket, 4 mils nominal thickness, 90 degrees C temperature rating. One conductor within each pair shall be numerically identified.

Pairs shall be assembled with a nominal 2-inch lay and shall then be group shielded with a minimum of 1.3-mil aluminum or copper tape overlapped to provide 100 percent coverage. All group shields shall be completely isolated from each other.

Instrumentation cables shall be installed in separate raceways. This includes through manholes. Instrumentation cable shall be continuous between instruments or between field devices and instrument enclosures. There shall be no intermediate splices or terminal boards.

The instrumentation cable shall be Type TC as manufactured by Okonite, Okoseal-N Type SP-OS, Belden equivalent or equal.

160204 GROUNDING

The grounding systems shall consist of concrete encased ground conductors and/or ground rods. Each duct bank shall contain a concrete encased system ground conductor. The system ground conductors shall

run continuously in duct banks, through manholes, handholes, and other raceway boxes. The system ground shall be connected to the structure grounding systems to provide a continuous ground system. Each metallic raceway, panel, switchboard, and other metallic devices associated with the electrical and instrumentation systems shall be bonded to this grounding system.

All equipment cases, devices, etc. shall be grounded. Ground rods shall be driven or concrete encased conductors installed before a building or structure is built and ground conductors brought through the concrete to accessible points for grounding equipment. These systems shall be installed at each structure where switchgear, motor control centers, switchboards, panelboards, etc. are installed.

Where ground conductors are not sized, the NEC shall govern. Driven ground rods shall be copperweld, or equal, 5/8-inch in diameter and not less than 10 feet in length.

All connections of ground cable to rods or to cable shall be thermoweld connections. Maximum allowable ground resistance shall be 3 ohms.

Tests shall be conducted by the Contractor and witnessed by the Engineer to determine the ground resistance for the entire system and at each building where there is switchgear, motor control, etc.

It is the intent of these Contract Documents that a grounding conductor for all device and equipment grounds shall be run as a separate conductor in the conduit from the equipment to the motor control center or system ground. All wireways, enclosures, etc. shall be properly bonded and grounded, and grounding conductors shall be run for all circuits. See drawings for additional grounding requirements.

160205 OUTLET, SWITCH, PULL AND JUNCTION BOXES

160205.01 GENERAL

Unless otherwise specified or indicated on the Plans, device boxes, condulets and junction boxes shall be heavy-duty cast and shall be compatible with the location and conduit system being used, rigid steel or rigid copper free aluminum and shall be as manufactured by Crouse-Hinds, Appleton, or equal, with stainless steel cover screws and with cover gaskets. Device boxes shall be FD type.

160205.10 FASTENERS

Fasteners used with wiring devices shall be aluminum or stainless steel and all screws, nuts, bolts, etc. shall be stainless steel.

160205.20 CONCRETE PULL BOXES

The Contractor shall furnish and install precast concrete pull boxes in the locations indicated on the Plans and as required.

The pull boxes shall be installed on 12 inches of compacted gravel and shall be installed in such a manner that the cover of the pull box will be flush with finished grade.

The pull boxes shall be designed for traffic conditions, and the pull box and cover shall be designed for heavy traffic bridge loading. The pull boxes shall be a minimum of 3 feet by 2 feet by 30 inches deep with 3/4-inch diameter pulling irons located at each end. The pull boxes shall be constructed of reinforced Class A concrete.

The pull boxes shall be Quickset, Utility Vault Company, or equal, with covers. The covers shall be engraved "ELECTRICAL."

160206 LIGHTING SWITCHES

160206.01 GENERAL

Snap switches shall have the number of poles as indicated on the Plans, shall be specification grade, rated at 20-ampere, and shall be as manufactured by Hubbell, General Electric, or equal. Special switches, covers, etc. shall be as specified herein or indicated on the Plans. All light switches shall be mounted at 42 inches above finished floor unless otherwise indicated on the Drawings.

160206.10 INDOOR

Stainless steel cover plates shall be utilized.

160206.20 OUTDOOR AND CORROSION RESISTANT

Enclosures shall be weatherproof.

160207 RECEPTACLES

160207.01 GENERAL

Duplex receptacles shall be 2-pole, 3-wire grounded, 120 volts, industrial, rated at 20 amperes, and shall be as manufactured by Hubbell, General Electric, or equal. Special receptacles, covers, etc. shall be as specified herein or as indicated on the Plans. All receptacles shall be mounted at 36 inches above finished floor unless otherwise noted on the Drawings.

160207.10 INDOOR

Stainless steel cover plates shall be utilized.

160207.20 OUTDOOR AND CORROSION RESISTANT

Enclosures shall be weatherproof with yellow "fiberglass" lift cover plates or accepted equal.

160207.30 GROUND FAULT INTERRUPTER RECEPTACLES (GFI)

GFI outlets shall be rated at 20 amperes at 125 volts AC as manufactured by Leviton, Bryant, or equal. All outdoor receptacles and receptacles mounted below grade, and in vaults shall be GFI type.

160207.50 240-VOLT RECEPTACLES

The 240-volt receptacles shall be of the ampere rating as indicated on the Plans, however, the minimum rating shall be 20 amperes at 250 volts AC and shall be as manufactured by Leviton, Bryant, or equal.

160208 PUSH-BUTTON STATIONS

160208.01 GENERAL

Push buttons, selector switches, and pilot lights (screw-on type) shall be heavy-duty, oiltight manufactured by Square D Company; General Electric Company; or equal. Control stations shall be in NEMA 4X enclosures (corrosion resistant, compression molded fiberglass) for outdoor and corrosive resistant (NEMA 4X) areas as designated on the Drawing and NEMA 12 for indoor installations. Lenses shall be clear not opaque. NEMA 4X enclosures and pushbuttons shall be Crouse-Hinds, N Series, Allen-Bradley 800 H Series, or equal.

"Start-Lockout-Stop" push-button stations shall be installed adjacent to every motor unless specifically indicated otherwise. Lockout mechanism shall be made of metal.

For MCC or control panel-mounted or stand-alone pushbutton stations, the pushbuttons shall be heavy duty oil tight, rugged construction with chromeplated lockrings and guards. All pilot lights shall be transformer push-to-test LED type.

160209 TRANSFORMERS - DRY TYPE

160209.10 DISTRIBUTION TRANSFORMERS - LOW VOLTAGE LIGHTING AND POWER

Transformers shall be of the premium high efficiency quiet type and shall be installed where indicated on the Plans. The primary winding of the transformers shall have two 2-1/2 percent taps above and below normal. All windings shall be copper.

The transformers shall have a BIL of 10 KV with a temperature class of 185 degrees C for transformers up to 25 KVA and a temperature class of 220 degrees C for transformers rated at 30 KVA and larger.

The sound level shall not exceed 44 dba measured at 5 feet from the transformer after installation. Core and coil assemblies 30 KVA and larger shall be mounted on rubber vibration isolators designed specifically to reduce 120 Hertz sound and multiple harmonics.

Transformer standards shall be submitted to the Engineer prior to purchase and installation.

Transformers shall be of the types manufactured by General Electric Company, Westinghouse Corp., or equal.

160209.20 ISOLATION TRANSFORMERS

Isolation transformers shall be provided for all solid state devices and elsewhere where indicated. Regulation shall be ± 3 percent for an input range of ± 10 percent. Common mode noise rejection shall be better than 120 db with transverse mode noise rejection better than 60 db. Voltage spike attenuation shall be better than 250:1.

Isolation transformers shall be as manufactured by Square D, Westinghouse, or equal.

160210 RELAYS

160210.10 CONTROL RELAYS

Control relays shall be General Electric, Westinghouse, Square D Company, or equal, industrial 600-volt, 10-ampere type with contact arrangement and operating coils of the proper voltage as required by the control circuit sequence. Each relay shall have a minimum of four reversible pole contacts. The coils shall be sealed by pressure molding.

160210.11 INTRINSICALLY SAFE RELAYS

Intrinsically safe relays shall allow the use of any type of remote pilot device located in Class 1 hazardous areas by providing a pilot circuit incapable of releasing sufficient electrical energy to ignite gases and vapors classified in Groups A, B, C, and D.

The unit shall have an output relay with double pole, double throw contacts rated at least 16 amperes at 120 volts AC, resistive load, and 24 volts DC. They shall operate on the AC supply voltage indicated on the Plans.

They shall be Cutler-Hammer, BW Series, or equal.

160211 TIMERS

160211.01 GENERAL

Timers which require pins or other removable trip devices shall be provided with at least one pin or trip device for each possible time setting.

160211.10 RESET TIMERS AND REPEAT CYCLE TIMERS

Timers of this type shall be heavy-duty industrial timers as manufactured by Eagle, Paragon, or equal.

160211.20 TWENTY-FOUR HOUR TIMERS

Timers of this type shall be heavy-duty industrial timers as manufactured by Paragon, Tork, or equal.

160211.30 TIMING RELAYS

Timing relays shall be heavy-duty industrial 600-volt, 10-ampere as manufactured by Square D Company, Westinghouse, or equal.

160211.40 AREA LIGHTING CONTROL TIMERS

Timers for use with area lighting circuits shall be of the astronomic dial type and shall have a day-omitting device. These timers shall be General Electric, Paragon, or equal.

160212 ENCLOSURES

160212.01 GENERAL

This specification includes enclosures to house electrical controls, instruments, terminal blocks, etc. If not indicated otherwise they shall be NEMA 12 for indoor and NEMA 4X for outdoor installations.

160212.10 CONSTRUCTION - STEEL

Enclosures shall be from 14-gauge steel with seams that are continuously welded. Doors shall have full length piano hinges with the door removable by pulling the hinge pin. They shall be as manufactured by Hoffman, Fischer & Porter, or equal.

A rolled lip shall be provided around three sides of the door and around all sides of the enclosure opening. The gasket shall be attached with oil-resistant adhesive and held in place with steel retaining strips. Exterior hardware, such as clamps, screws, and hinge pins, shall be of stainless steel for outdoor installations. A hasp and staple shall be provided for padlocking. Each enclosure shall have a print pocket.

160212.11 FINISH - STEEL

Finish shall be white enamel interior, light grey enamel, ANSI 61 exterior, over phosphatized surfaces. Special finishes and colors shall be furnished for wet locations. Plans should be checked for special conditions.

160212.20 CONSTRUCTION - FIBERGLASS NEMA 4X

Enclosures shall consist of base and cover which shall be heavy-duty hot compression molded from fiberglass reinforced polyester compound containing not less than 25 percent fiberglass by weight. Transparent covers, where indicated, shall be polycarbonate. The enclosures shall be provided with cover hinges manufactured from nonmetallic materials. The cover latch system shall be nonmetallic.

The gasket system shall be of neoprene material cemented into a molded labyrinth on the cover.

The enclosures shall be NEMA 4X and shall be as manufactured by Crouse-Hinds, English Electric Corp., or equal.

160213.30 PANELBOARDS

160213.31 GENERAL

Dead-front panelboards, including lighting distribution and control panels, shall be furnished and installed as indicated on the Plans. All bus shall be copper. Mounting and type enclosures shall be as indicated on the Plans. Where not indicated, indoor enclosures shall be NEMA 12 and outdoor enclosures shall be NEMA 4. The minimum interrupting capacity of any device shall be 10,000 amperes.

160213.32 INTERIORS

Protective devices shall be such that they can be replaced without disturbing adjacent units. Wire connectors shall be suitable for wire sizes indicated. Branch circuits shall be numbered as indicated on the Plans and a complete typed circuit schedule shall be furnished under a transparent cover and affixed to the panel. Phase busing shall be full height without reduction. Full size neutral bars shall be included and shall have suitable lug for each outgoing circuit requiring neutral connection. Spaces for future protective devices provided in lighting panels shall be bused for the maximum device that can be fitted into them.

160213.33 ENCLOSURES

Panelboards shall be finished with a primer, rust-resistant phosphate undercoat and two coats of oven-baked enamel with finish color to be accepted by the Engineer. They shall have sufficient size to provide a minimum of 4 inches of gutter space on all sides. Doors shall be such that they:

- A. In making switching devices accessible, shall not uncover any live parts;
- B. Are hinged and have latches that require no tool to operate; and

- C. Can be locked. Lock and two keys shall be furnished.
- D. On door inside pocked to hold typed circuit directory.

160213.34 IDENTIFICATION

Each panelboard shall have, on the outside of the door, a lamicoïd nameplate with 3/4-inch letters as specified elsewhere in these Contract Documents.

Panelboards shall be as manufactured by Westinghouse, General Electric, or equal.

160214 LOW VOLTAGE POWER FACTOR CORRECTION CAPACITORS (INDOOR)

160214.01 GENERAL

The Contractor shall furnish and install, as indicated on the Plans, or as required by other DIVISION, power factor correction capacitors. They shall be Sprague "Univar," Westinghouse "MDP," or equal.

A heavy frame, jig welded to assure accurate alignment and proper ventilation of units and tiers when used in stacked multiple assemblies, shall be furnished. Rack spacing shall be carefully designed to minimize overall dimensions, yet provide adequate ventilation.

160214.10 INDIVIDUAL CAPACITORS

The case shall be made from heavy gauge steel with all joints welded and reinforced at points of wear. Cases shall be with both protective primer and tough grey enamel finish coat.

Internal discharge resistors shall be furnished which will reduce the residual voltage to less than 50 volts within one minute after removal from the circuit. Individual unit indicating type current limiting fuses shall be furnished and installed.

160215 THERMOSTATS

Thermostats shall be heavy-duty thermostats with full load rating of 120-volt, 16-amp, and shall be Honeywell T6051 Series, Rockwell, or equal.

160217 ALARM HORNS, BUZZERS AND BEACON LIGHTS

160218 TERMINAL BLOCKS

Terminal blocks shall be 600 V rated Square D Company, Buchanan, or equal. Terminal blocks shall be of the size required for conductors therein and a minimum of 50 percent spares shall be provided in each terminal box.

160219 DISCONNECT SWITCHES

Disconnect switches shall be heavy-duty safety switches with a quick-make, quick-break operating mechanism, full cover interlock and indicator handle. The disconnect switches shall be furnished with fuses of the size indicated on the Plans. One set of spare fuses shall be furnished for each fused disconnect switch.

Disconnect switches shall be as manufactured by Square D, Westinghouse, or equal.

160220 PHOTO ELECTRIC CELL UNIT

The photo electric cell unit shall be used for automatic control of lighting fixtures as noted on the Plans. The photo electric cell unit shall be in weatherproof enclosure and shall be suitable for 120V AC control circuit with 30A rated contact for switching lighting circuit. The photo electric cell unit shall be as manufactured by General Electric, Paragon equivalent or equal.

160300 ELECTRICAL METERING AND RELAYING

160300.01 GENERAL

Instruments, relays, and other devices for panels shall be flush or semiflush mounted with cases of similar design.

Instruments shall have antiglare glass fronts, antiparallax scales, and white faces with black numerals and markings. Instruments shall be selected with the full-load reading at approximately 75 percent of full scale, unless otherwise specified or accepted. Accuracy of instruments shall be one percent of full scale values. Transformer accuracies shall be suitable for relays and meters.

160300.10 POTENTIAL TRANSFORMERS

Potential transformers shall be indoor, dry type, single phase, 60 Hertz, with 120-volt secondary and rated as required for the equipment furnished. They shall be furnished with current limiting fused disconnects. They shall be equipped with resistors as required to limit the fault current to a value which the fuse is able to interrupt without damage.

Medium voltage potential transformers shall be mounted on a carriage in a separate compartment within the stationary structure. It shall be arranged so that the carriage must be withdrawn to permit access and the withdrawal shall, through a self-aligning, multipole connector with silver to silver contact surfaces, disconnect the primaries and secondaries and automatically connect the primaries to ground potential.

160300.20 CURRENT TRANSFORMERS

Current transformers shall be indoor, dry type insulated for the voltage for which it is used and rated as required for the equipment furnished. They shall have sufficient thermal and mechanical capacity to withstand the maximum momentary current rating of the associated circuit breaker.

161000 MOTOR CONTROL CENTERS (MCC)

161000.01 GENERAL

The Contractor shall furnish and install, ready to use, completely engineered and assembled motor control centers for use as indicated on the Drawings and specified herein.

The motor control centers shall be manufactured Allen Bradley, Square D, or equal. The motor control center fabricator shall also be the manufacturer of the major components therein. Engineered motor control centers shall be by the component and housing manufacturer. The manufacturer shall comply with other sections of this specification describing components such as dry-type transformers,

panelboards, relays, circuit breakers, motor short circuit protectors, magnetic starter, pilot devices, and other such equipment which will be components within the motor control center.

161000.02 STANDARDS

Each component, as well as the complete assembly, shall be constructed and tested in accordance with latest NEMA Standards for Industrial Control. The vertical sections and individual units shall bear a UL label, where applicable, as evidence of compliance with UL 845. The type of construction of the control centers shall be NEMA Class II, Type B. Lifting eyes shall be provided on each section to facilitate handling.

Unit doors shall be mounted on the stationary structure and hinged on the side away from the vertical wireway. They shall be held closed with slotted thumb screws.

Unit doors shall have positive action linkage with disconnect operating mechanism. Mechanism shall be designed so that it can be locked in the OFF position with from 1 to 3 padlocks. When the handle is not padlocked, it shall be possible to open the door by releasing the door interlock with a small tool. The control units shall be of the plug-in type. When doors are closed, the operating mechanism shall clearly indicate whether the disconnect is in the ON or OFF position, and the door interlock shall automatically become effective. The disconnect operating mechanism shall be designed against inadvertent operation when the door is open. Each plug-in unit door shall be provided with a nameplate, specified elsewhere herein, that indicates the circuit number and circuit name and tag number (where applicable). The nameplate shall be attached to the door with stainless steel screws.

It shall be possible to install up to six NEMA size one units in one vertical section. Units shall be completely enclosed with sheet steel. A small wireway shall be provided inside of unit so all wiring can be laid in place without removing barriers or plates. Each vertical section that holds the units shall be rigidly formed of minimum 12 gauge, cold-rolled sheet steel. The vertical front-of-board-construction shall be supplied with a 20 inch depth.

Continuous horizontal wiring troughs shall be provided at both top and bottom of each section. These troughs shall line up to form a continuous wireway for the full length of the center. A large continuous, full height vertical wiring trough shall be provided in the right side of each section.

All starter wiring, control and power, shall be terminated on terminal strips provided in each unit for Size 2 and smaller starters. Size 3 and larger starters shall have control leads terminating on the terminal strips. Terminal strips shall be split-type to facilitate wiring connections without disconnecting factory or field conductors. Terminal strips shall be as specified in another Section of these Specifications and shall be rated to accept conductor sizes as specified herein and as indicated on the Drawings. All terminal strips shall be provided with a minimum of 25 percent spare terminals.

All control wiring within each unit and interconnection wiring between units shall be copper, Type MTW, 90 degrees C, 600 V, No. 14 AWG (minimum). Power wiring shall be sized to suit maximum horsepower rating of unit, No. 12 AWG minimum. All power and control wiring shall be identified at each termination point (both ends) in accordance with the approved shop drawings using appropriate labels specified in another Section, manufactured by Brady; Seaton; or equal.

Each MCC shall be provided with an electronic metering package which provides indication and display of current, voltage, powerfactor, watt, etc.

161000.10 BUS

Horizontal bus bars shall be tin plated copper and shall be of the ampacity indicated on the Drawings. Unit bus bar stabs shall insure high contact pressure. The vertical bus bars shall be effectively isolated from accidental contact by plastic insulating medium in all units including spaces. The entire vertical bus shall be tin-plated copper.

Bus bar supports shall be of high impact strength, non-carbonizing insulating material mounted on padded steel brackets and shall provide adequate dielectric strength and creepage distance. The bus structure shall be capable of withstanding a not less than 65,000 rms ampere short circuit current in accordance with NEMA standards. In the event that the results of the Contractor's short circuit fault analysis, as accepted by the Engineer, indicates that a higher short circuit duty rating of the motor control center is required, the MCC shall be furnished with that higher rating.

Horizontal bus other than 600 Amperes and vertical bus other than 300 Amperes shall be as specified herein or indicated on the Drawings.

A tin-plated copper horizontal ground bus shall be provided which shall be continuous across the full length of the MCC. A copper vertical ground bus, which is solidly connected to the horizontal ground bus, shall be provided in each vertical section containing starter or feeder units. The vertical ground bus shall have all required provisions for connecting the equipment grounding conductor at the associated unit location.

161000.20 MOTOR CONTROL CENTER ENCLOSURES

The motor control centers shall be as indicated on the Drawings and as specified herein and in accordance with NEMA Standard Pub. IS 1.1, latest edition. Unless otherwise specified herein or indicated on the Drawings, the motor control centers shall be enclosed in NEMA Type 12 enclosures.

161000.30 PAINTING

All metal surfaces and structural parts shall be given a phosphatizing, or equal, treatment prior to painting. The control centers shall then be given a gray undercoat which is equal to zinc chromate. Interior surfaces including bus support angles, control unit back plates, and top and bottom unit barrier plates shall be baked white enamel. The exterior of the enclosure shall be ANSI 61 or finished in a color selected by the Engineer.

161000.40 FUTURE SPACE REQUIREMENTS

In the motor control centers are spaces for future combination starter and other units. These spaces shall have all the hardware necessary so that a future plug-in control unit can be installed without having to modify the vertical sections. The number of spaces for future control units shall be as indicated on the Drawings. Additional vertical sections, which may not necessarily be indicated on the Drawings, shall be provided to ensure that the total number of spaces indicated on the Drawings are indeed provided. This may be contingent upon the specific manufacturer's final approved layout of the MCC units.

161000.50 DEVICES

Devices, such as, but not limited to, magnetic starters, circuit breakers, relays, timers, push buttons and other pilot devices, nameplates, conductors, circuit identification, shall conform to other specification sections.

161000.60 INFORMATION FOR REVIEW

The motor control centers shall meet the requirements of the latest edition of Standards for Industrial Control No. ICS published by the National Electrical Manufacturers Association. The following minimum information and drawings shall be submitted:

- A. Plan, front, side views and overall dimension of each motor control center. Identified shipping splits, if required.
- B. Internal wiring diagram of each plug-in unit including wire identification and terminal numbers. All devices, regardless of their physical location, shall be indicated on these diagrams. The specific device location symbols as indicated on the Drawings shall also appear on these diagrams.
- C. Internal wiring diagram of the motor control centers.
- D. External connection diagram showing the wiring to the external controls and devices associated with the motor control center.
- E. A one-line and a schematic diagram for the motor control centers.
- F. Bill of material list.
- G. Upon acceptance by the Engineer, Contractor shall submit two sets of contract record drawings of motor control centers system. Drawings and details shall be referenced explicitly to the contract drawings by circuit numbers, equipment designations, and locations.
- H. Nameplate Schedule.

161000.80 MOTOR CONTROL CENTER INSTALLATION

Motor control centers shall be installed to allow complete unit door swing which is required for unit removal. Specifically where a vertical section of MCC is set next to a wall to the left of the MCC section.

161000.90 SPARE PARTS

In addition to spare devices installed in the MCC as shown on the Plans, the Contractor shall provide the following spare parts to the Owner at no additional cost. The spare parts shall be listed in bills of material.

- A. 2 start pushbuttons
- B. 2 stop pushbuttons
- C. One dozen pilot lamps (LED push-to-test type)
- D. 1 dozen control fuses 480 V - 120 V
- E. 1 H-O-A selector switches

161100 CIRCUIT BREAKERS - LOW VOLTAGE

161100.01 GENERAL

All circuit breaker frame and trip ratings shall be as indicated on the Plans, except that they shall be coordinated with the ratings of the equipment actually furnished and shall be modified where necessary to suit this equipment. Circuit breakers to be used in motor control centers shall be as indicated on the Plans. Where no indication of type is given on the Plans, the following shall govern:

Circuit breakers protecting motors rated 7.5-horsepower or less shall be motor circuit protectors, all other circuit breakers shall be molded case circuit breakers.

Circuit breakers shall be as manufactured by Westinghouse, General Electric, or equal.

161100.10 MOLDED-CASE CIRCUIT BREAKERS

Circuit breakers for mounting in motor control centers or for separate mounting shall be of the air-break type, quick-make and quick-break, 600-volt, with number of poles as indicated on the Plans. The minimum frame size shall be 100 amperes.

Each pole of these breakers shall provide inverse time delay and instantaneous circuit protection.

The breakers shall be operated by a handle and shall have a quick-make, quick-break switching mechanism that is mechanically trip free from the handle so that the contacts cannot be held closed against short circuits and abnormal currents. Tripping due to overload or short circuit shall be clearly indicated by the handle automatically assuming a position between the manual ON and OFF positions. All latch surfaces shall be ground and polished. All poles shall be so constructed that they open, close and trip simultaneously.

Breakers must be completely enclosed in a molded case. Non-interchangeable trip breakers shall have their covers sealed; interchangeable trip breakers shall have the trip unit sealed to prevent tampering. Ampere ratings shall be clearly visible. Contacts shall be of non-welding silver alloy. Arc extinction must be accomplished by means of arc chutes.

The minimum interrupting ratings of the circuit breakers shall be at least equal to the available short circuit at the line terminals.

Circuit breakers shall conform to the applicable requirements of NEMA Standards Publication No. ABL.

Circuit breaker ratings, modifications, etc. shall be as indicated on the Plans.

Molded case circuit breakers shall be ambient compensating that provides inverse time delay overload and instantaneous short circuit protection by means of a thermal magnetic element. Compensation shall be accomplished by a secondary bimetal that will allow the breaker to carry rated current between 25 degrees C and 50 degrees C with tripping characteristics that are approximately the same throughout this temperature range.

On breakers with interchangeable, thermal, adjustable magnetic trip, the accessibility and position of the adjustment knob shall not be changed from those on the standard breaker.

161100.20 MOTOR CIRCUIT PROTECTORS

Electrical circuits shall be protected by motor circuit protectors (MCP) as manufactured by Westinghouse Electric Corporation, General Electric, or equal.

The MCP shall be operated by a handle and shall have a quick-make, quick-break switching mechanism that is mechanically trip free from the handle so that the contacts cannot be held closed against short circuits and abnormal currents. Tripping shall be clearly indicated by the handle automatically assuming a position between the manual ON and OFF positions. All latch surfaces shall be ground and polished. All poles shall be so constructed that they open, close, and trip simultaneously.

MCP's must be completely enclosed in a molded case. MCP's shall have the trip unit sealed to prevent tampering. Ampere ratings shall be clearly visible. Contacts shall be of non-welding silver alloy. Arc extinction must be accomplished by means of arc chutes.

Each pole of these MCP's shall provide instantaneous short circuit protection by means of a single adjustable magnetic only element. The single adjustment screw shall adjust all poles simultaneously.

Provision shall be furnished in the MCP for locking the maximum achievable trip setting to values less than maximum obtainable trip setting. Each adjustment shall have eight main setting points and mid-setting points following a linear scale so that each point has a significant value within calibration tolerances.

MCP's shall be suitable for use with current limiters, having 100,000 ampere interrupting capacity and a built-in trip indicator that are fully coordinated with the MCP so that the MCP will open all three phases if the limiter operates. Current limiters shall be so constructed that they can only be replaced by an identical or similar limiter having the same interrupting capacity.

The minimum interrupting ratings of the MCP shall be at least equal to the available short circuit at the line terminals.

MCP ratings, modifications, etc., shall be as indicated on the Plans.

161100.40 MODULAR OVERLOAD RELAYS

Where called for on the Plans, modular overload relays shall be provided with the motor starters. The modular overload relays shall be 3-pole solid state devices set by one plug-in heater and shall protect all three phases of the motor in ambient temperatures ranging from -20 degrees to +70 degrees C.

The jam modules shall plug in the modular overload relays and shall provide for instantaneous trip of the overload relay should the current exceed a preset value at any time after the motor has accelerated. The modules shall be adjustable to any value between 150 percent and 400 percent of the motor full-load current.

The underload modules shall plug in the MOR and shall provide for overload relay trip whenever the current falls below a set value after the motor has accelerated. The modules shall be adjustable between 50 percent and 90 percent of the full load value of the motor full load current.

Each module shall provide individual trip indication and reset for each trip condition, visible without opening the motor control center compartment door. Each module shall provide an auxiliary contact for remote trip indication.

All solid state circuits shall be completely protected from damage arising from line transients and voltage spikes.

They shall be as manufactured by Westinghouse, Square D Company, or equal.

161200 MOTOR CONTROL - LOW VOLTAGE

161200.01 GENERAL

Starters Size 2 and larger shall have arc quenchers on all load breaking contacts. Starters shall be suitable for the horsepower ratings specified, except the Contractor shall verify the motor ratings and coordinate the starter and overload trip ratings with the actual horsepower ratings of the motors installed. Extended overload reset buttons shall be mounted so as to be accessible for operation without opening the door of the enclosure.

Magnetic contactors shall be factory adjusted and shall be chatter free. Magnetic contactors shall have bimetallic type overload relays in each line conductor as indicated on the Plans.

Starters shall be furnished complete with a 120-volt control transformer unless otherwise noted.

Where above normal ambient temperatures are anticipated, circuit breaker trip elements and starter overload trip elements shall be supplied to meet such conditions and shall be acceptable to the Engineer.

Control fuses shall be furnished where indicated in the schematics.

The magnetic contactors shall not be smaller than the size indicated on the Plans. Starters shall be sized to handle motors furnished even if motors should be larger than indicated on the Plans.

The minimum size starter shall be NEMA Size 1.

161200.10 MANUAL STARTERS

Manual starters as indicated on the Plans shall be across-the-line manual motor starters for motors up to one Hp, 600V having the electrical characteristics indicated on the Plans.

Manual starters shall have: Enclosures as indicated on the Plans, handles that clearly indicate the ON, OFF with lockout, and TRIPPED positions, pilot light, and positive, quick-make, quick-break mechanisms.

The manual starters shall be Square D, Westinghouse Electric Corporation, or equal.

161210.20 MAGNETIC STARTERS

161210.21 FULL VOLTAGE

Across-the-line full voltage magnetic starters for up to 600V shall have electrical characteristics indicated on the Plans.

Magnetic starters shall have: NEMA 12 enclosures unless otherwise noted; positive, quick-make, quick-break mechanisms; padlockable enclosure doors; three overload relays ± 15 percent adjustment from

nominal heater rating on the overload relay; cover mounted reset button; and at least three reversible contacts in addition to the hold-in contact.

Magnetic starters shall be built in accordance with the latest NEMA Standards and shall be manufactured by Westinghouse Electric Corporation, General Electric, or equal.

161220 SOLID STATE REDUCED VOLTAGE STARTERS

161220.10 GENERAL

Solid state reduced voltage starters (SSRVS) shall be microprocessor controlled, fully digital, suitable for use with three phase induction motors rated 600 VAC or less. It shall provide a closed loop current ramp for smooth and stepless motor acceleration and deceleration.

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161220.10 GENERAL

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161220.11 SYSTEM DESCRIPTION AND QUALIFICATIONS

1. SSRVS shall be a product of a manufacturer who has produced solid state reduce voltage starters for a minimum of 10 years (consecutive).
2. The solid state reduced voltage starters shall be manufactured by:
 - a) Benschaw, Inc., Redi-Start Micro Series or equal.
 - b) Distributor / warranty service center shall have a complete inventory of spare parts and 24-hour on-call service engineers which are authorized by the manufacturer to perform warranty work on site.
3. The SSRVS shall be Underwriter's Laboratory (UL) labeled where UL has such a listing.
4. The SSRVS shall be designed, manufactured and tested to conform, where applicable, to the following industry standards and specifications:

a) ANSI	e) NEC
b) CSA	f) EEMAC
c) IEEE	g) NEMA
d) UL	h) OSHA
5. Solid state starter performance requirements:
 - a) Nominal operating ambient temperatures: 0 - 40 degrees C (32 - 104 degrees F) with a relative humidity of up to 95% (noncondensing).
 - b) Power: Operate with three phase AC power at nominal voltages of 100 thru 600 VAC.
 - c) Frequency: Operate between 25 through 70 Hz.

- d) Meet Uniform Building Code on non-building structures, Section 2338, for zone 1, 2, 3, and 4 requirements.

6. Design Criteria:

DESCRIPTION	SPECIFICATION
Horsepower	As per Plans
Power Ratings	600% for 30 sec. And 125% cont.
PIV Ratings	2.5 x line voltage or 1600 V minimum
Starting Torque	0 to 100%
Ramp Time	0 to 120 seconds
Deceleration Time	0 to 60 seconds
Nominal ratings	100 through 600 VAC 25 through 70 Hz. With frequency tracking within this range
Standard Insulation Test	2500 VAC minimum
Overall Efficiency	Average 99.7%
SCR Firing Technique	Hard Drive with “picket fence”
Transient Voltage Protection	DV/DTs or SIOVs
Diagnostics and LEDs	Power On Gate Power Micro Computer Fault SCR Condition LCD display (16 char. X two lines.)
Control Input	120 VAC or dry contact, 2/3 wire

161220.12 SUBMITTALS

1. The following drawings information shall be supplied by the solid state starter manufacturer with the shipment of each starter or for approval before releasing the starters for production.
 - a) Elementary wiring diagrams.
 - b) Wiring and interconnect diagrams.
 - c) Enclosure frontal elevation and dimension drawings.
 - d) Internal component layout diagrams.
 - e) Available conduit entry and exit locations.
 - f) Manufacturers product data sheets.
 - g) Instruction manuals required for proper operation of the solid state starters.

161220.13 ENCLOSURE CONSTRUCTION

The solid state starter shall be located in the MCC as shown on the Plans. The circuit breaker operator shall interlock cabinet door and shall be pad-lockable.

161220.14 BYPASS CONTACTORS

1. A bypass contactor shall be supplied. This bypass contactor shall bypass the SCRs of the solid state starter once the motor is up to speed. The effect of the bypass contactor during run shall be for the elimination of heat buildup resulting from the voltage drop across the SCRs of the solid state starter.
2. Bypass contactor shall be sized per NEMA standards for full voltage across-the-line starting and continuous operation. Units with integral bypass relays which cannot be operated as FVNR starter shall not be allowed.
3. The bypass contactor will not be used to start the motor. The bypass contactor shall be either a stand alone type or an integral type as supplied by the solid state starter manufacturer.

161220.15 SOLID STATE STARTER LOGIC CONTROL CONFIGURATION

1. Description
 - a) The solid state starter shall be supplied standard with programming buttons and local start/stop buttons on one main keypad with LCD display.
 - b) Standard starter control logic shall be located on a microprocessor-based PC card which provides the sequential logic for the starter and gate signals to the power card which is used to drive the SCRs.
 - c) Design control logic to perform timing required for operation of the solid state starter and bypass contactor (if specific herein) while continuously monitoring motor and starter for faults. If a fault is detected, the control logic of the solid state starter to disable the motor.
 - d) The PC cards of the solid state starter shall be interchangeable with other control logic cards on starters of a similar design.
2. Electrical
 1. The logic control of the solid state starter shall incorporate a micro computer which consists of all circuitry required to drive the power semiconductors and provide motor and starter monitoring functions.
 2. The solid state starter logic shall provide the following standard features:
 - a. Adjustable Ramp Time (0-120 seconds)
 - b. Adjustable Initial Current (50-400% of motor FLA)
 - c. Adjustable Max Current (200-600% of motor FLA)
 - d. Dual Ramp Capabilities (both selectable and programmable)
 - e. Kick Start (adjustable .1-10 seconds)
 - f. Adjustable Decel Profile for Pumps
 - g. Over/Under Current Fault Protection (used in pumping applications for indicating blocked pump feed or pump jam)
 - h. Line Phase Loss Detection
 - i. Adjustable Line Current Imbalance Detection (10-40%)
 - j. Adjustable Over/Under Line Voltage Protection (10-30%)
 - k. Up To Speed Indication
 - l. Line Phase Sequence Sensitivity or Insensitivity

- m. Selectable Solid State Overload Class (5, 10, 15, 20, 25, 30, None)
 - n. Selectable Motor Service Factor (1.0, 1.15, or 1.25)
 - o. Adjustable Motor Full Load Amperes
 - p. Adjustable Current Transformer Ratio
 - q. Battery “Backup” of Set Starter Parameters
 - r. Real Time Clock
 - s. Selectable Passcode Protection of Set Starter Parameters
 - t. Line Voltage Independent Operation
 - u. Line frequency Tracking (25Hz Through 70Hz)
 - v. Over/Under Line Frequency Protection
 - w. Instantaneous Overcurrent Detection
 - x. Shorted SCR Detection
 - y. Machine Ground Fault Protection
 - z. Starts Per Hour Limiter (Via LCD display)
 - aa. Elapsed Time Meter (Via LCD display)
 - bb. Time Between Starts Limiter
 - cc. Power Factor Monitor
 - dd. Watt and Watt/Hour Meter
 - ee. Emergency Restart Capabilities on Lockout
 - ff. Software Selectable (Via LCD) Relay Outputs
 - gg. “Revolving” Event Recorder (99 most recent events)
 - hh. LCD Status Display
 - ii. Standard features shall operate concurrently.
3. The solid state starter logic shall provide the following standard features:

3. LCD Status Display

- 1. Each solid state starter shall have a keyboard/LCD display assembly designed to:
 - a. Set or examine operating parameters.
 - b. Provide starter status information.
 - c. Provide real-time information about line current, voltage and frequency.
 - d. Provide a means to start and stop the solid state starter.
- 2. The LCD display for the solid state starter shall be mounted on the door of the starter enclosure for viewing from the outside of the enclosure.

4. D. LED Indicators

- 1. The following LED indicators shall be provided for advisory status and fault annunciation:
 - a. Power On
 - b. Micro Computer Fault
 - c. SCR Gate Drive Power
 - d. SCR Condition

163100 LIGHTING

163110 GENERAL

Lighting fixtures shall be as described below and as indicated on the Plans.

Fixtures shall include lamps, ballasts, poles, mounting hardware, etc. to provide complete operating units.

Lamps shall be as manufactured by Westinghouse, Sylvania, or equal. High pressure sodium lamps shall be color corrected.

Fluorescent fixtures shall be rapid start type.

Catalog data including applicable coefficients of utilization tables, isolux chart of illumination on a horizontal plane, beam efficiency, horizontal and vertical beam spread, and beam lumens shall be submitted to the Engineer for review and acceptance for all fixtures before fixtures are manufactured. Substitutions will be permitted only if acceptable to the Engineer.

Fixtures shall be as designated in the fixture schedule.

163120 INSTALLATION

Surface and flush mounted fixtures shall be solidly connected to a junction box. Suspended fixtures shall be hung utilizing pendant mounting or stainless steel chains and hooks. Each fixture, or row of fixtures, shall be electrically connected by a length of Type SO flexible cord, 3-conductor No. 14 AWG, minimum, with a twist-lock plug to a twist-lock receptacle mounted in an individual junction box. Plugs and receptacles shall be as manufactured by Hubbell, General Electric Company, or equal.

Pole mounted fixtures shall be mounted on steel or aluminum poles as designated in the fixture schedule or Plans. All metal poles shall be bonded to the plant ground system. Poles shall have adequate handholes and weatherproof receptacles where indicated. All anchor bolts and nuts shall be stainless steel. Contractor shall paint all steel poles with aluminum paint or other color in accordance with these Contract Documents.

163130 BALLASTS

A. Ballasts shall be:

1. Energy saving type, suitable for use with energy saving lamps.
2. High power factor type, with a power factor not less than 90 percent.

B. Ballasts for fluorescent lamps:

1. Shall bear CBM and ETL labels certifying that the ballasts meet the pertinent requirements of such organizations.
2. Shall have a built-in thermal protector that disconnects the ballast permanently prior to failure.
3. Shall be high efficiency and constant wattage type.
4. Shall be of two windings where required by applicable codes.
5. Shall be manufactured by Advance, Universal, or equal.

C. Ballasts for high intensity discharge

163140 FIXTURE SCHEDULE

See plans for lighting schedule.

165610 OCCUPANCY SENSORS

Wall Switch Occupancy Sensors will be provided for all switches in the building to provide energy savings and convenience. All sensors shall be capable of operating normally with electronic ballasts, PL lam systems, motor loads and any other passive infrared or microwave systems. The manufacturer shall have a minimum of five years of experience in the sensor and lighting control industry. Sensors shall be compatible with the specific lighting types controlled. All sensors shall be of the same manufacturer, mixing brands of sensors is not acceptable. The wall switch shall meet the following minimum requirements:

1. Utilize active ultrasonics to detect motion and dual element pyroelectric detector behind a lens to detect the motion of infrared energy emitted by a human; lens shall be of the multi-element type that divides the field of view into forty zones of detection
2. Fit a single gang switch box and utilize a decorator cover plate.
3. Not protrude more than 0.75 inches from switch box
4. Have two ultrasonic transmitters and one receiver
5. Incorporate an inrush current limiter circuit to protect the relay contacts
6. Utilize a dry relay contact for control of the lighting load
7. Have a time out adjustment from 8 seconds to 32 minutes. The timer shall be linear and controlled by a timer chip
8. Automatic sensitivity adjustment and be microprocessor controlled
9. Automatic gain setback to reduce the sensitivity after the sensor has turned off the lighting to prevent false tripping
10. Provide a 180 degree field of view, coverage up to 1,200 square feet, and shall detect six inches of hand movement towards the sensor at a distance of 22 feet; detect body motion towards the sensor at a distance of 32 feet
11. Rated for 40 to 740 watts at 120 VAC and 90 to 1400 watts at 277VAC
12. Automatic on and shall have an automatic to off override switch on the unit
13. Air gap switch to disconnect power to the lighting load
14. Real time motion indicator on the front of the unit
15. Mount to a single or double gang switch box
16. Operate at 120VAC and 277VAC.
17. Sensor shall have an Automatic/OFF switch on front of unit.
18. Sensor shall incorporate a daylight control. The adjustable ambient light control shall be adjustable from 20 to 420 foot-candles.

19. Sensor shall use a dry contact relay to control the lighting load.

166100 RUNNING TIME METERS

Running time meters shall be non-resettable and measure up to 99999.9 hours and shall draw less than 5 watts of 120 V 60 Hz. The digits shall be at least one quarter inch high. They shall be Cramer 635 Series, Simpson equivalent or equal.

*** END OF DIVISION 16 ***

DIVISION 17

INSTRUMENTATION

170000 GENERAL

170000.10 REQUIREMENTS

The Contractor shall furnish and install, ready for use, the complete control/instrumentation systems as indicated on the Plans and in each of these Contract Documents. These documents include descriptions of functional operation and performance, as well as standards, but do not necessarily enumerate detailed specifications for all components and devices which are necessary. However, all components and devices shall be furnished and installed as required to provide complete and operable systems for accomplishing the functions and meeting the performance set forth hereinafter. Each control/instrumentation system specified shall be separate and distinct and shall be the responsibility of a single manufacturer for the design, construction and furnishing of the desired control hardware, mechanical drawings, interconnection drawings, control piping layout drawings, control conduit layout drawings, internal drawings, installation and start-up supervision and/or calibration of the control equipment. The responsible manufacturer as described in the preceding sentence shall hereinafter be referred to as the "primary manufacturer" and shall bear the responsibility for furnishing a fully complete system operating in a satisfactory manner.

In addition to this Division of the Specifications, the Work shall conform to the applicable requirements of the other Divisions of the Contract Documents including the following Divisions:

- Division 1 - Special Conditions
- Division 5 - Metals
- Division 6 - Wood and Plastic
- Division 9 - Finishes
- Division 14 - Mechanical Equipment
- Division 15 - Piping
- Division 16 - Electrical

The control/instrumentation systems shall be furnished and installed by the Contractor complete and ready to operate, including all necessary interconnections and connections to sources of electrical power, air, water, drains and vents, with all required valves, switches and accessories as specified or as recommended for best operation by the manufacturer of the equipment furnished. All necessary mounting panels, stands, hangers and brackets shall be furnished and installed and shall comply with the relevant sections of these Contract Documents. In general, overall system accuracy shall be within plus or minus three percent of the actual process parameter being controlled (flow, temperature, etc.), unless otherwise specified.

Where two or more manufacturers are concerned in furnishing equipment for a single-control/instrumentation system, Contractor shall supply the primary manufacturer with such information and drawings from other manufacturers as are needed to fit their equipment into the control or instrumentation system or panels. All equipment with interconnects shall be shown together on one coordinated drawing. All equipment system design proposed to be furnished shall be coordinated and submittals for the equipment shall be bound in book or booklet form before the equipment will be evaluated for acceptance.

The Contractor shall include in his bid allowance for factory-trained service personnel, other than sales representatives, to supervise installation of and to adjust all the control and instrumentation equipment until

this equipment has been field-tested by the Contractor and the results of these tests have been reviewed by the Engineer. In addition, factory bench-test data shall be submitted to show that the manufacturer's proposed equipment has been tested in the specified arrangement and found to achieve specified accuracy. The Contractor shall also include in his bid for training of personnel in the operation and maintenance of the furnished control systems. Training shall include at least eight four hour sessions for two designated employees. Training shall include hands-on instructions and equipment operations.

The following drawings shall be submitted to and returned reviewed before fabrication is started:

- A. Layout drawings of system showing wiring, piping, valves, switches, and control units in schematic form. This includes individual loop drawings and total integrated system drawings.
- B. Shop drawings of panels or enclosures showing size, arrangement, color, and nameplates.
- C. Bill of material and catalog data on all equipment, wiring, conduit, tubing, and such other accessories as are needed to properly operate the control/instrumentation system.
- D. Wiring diagrams of all electrical work including conduits and piping diagrams of pneumatic/hydraulic systems.

Upon acceptance, Contractor shall submit three sets of "as-built" drawings of the control/instrumentation systems. Also, instruction manuals, installation, operation and maintenance instructions shall be submitted in triplicate for each item, instrument, etc., prior to installation.

The Contractor and suppliers are cautioned regarding the review and compliance with the total Contract Documents. Typical examples are control relays, timers, enclosures, and nameplates. These particular items are sometimes furnished and installed by an instrument supplier; however, they are specified in DIVISION 16 of these Contract Documents.

All work covered under this Division shall comply with the Instrument Society of America (ISA) Standards and Practices for Instrumentation.

170000.15 WORK INCLUDED

- A. Furnish and install new instrumentation specified under this Division.
- B. Install and/or connect instrumentation furnished under other Division.
- C. Testing of instrumentation and control system.

170000.20 CONTROL AND INSTRUMENTATION DEVICES

Control mechanisms shall be standard devices constructed of corrosion-resistant materials, enclosed in a dustproof case and mounted as specified in the individual application. Instruments to be mounted outdoors or in basements shall be in weatherproof cases. Corrosion resistant cases shall be furnished where indicated. Cases shall be finished in manufacturer's standard colors except as otherwise specified. All instrument wires or cables shall be enclosed and not exposed or within reach of the public.

Each meter, indicator, totalizer, controller, recorder or other device shall have an identifying engraved lamicoid nameplate. This includes all primary elements, such as flow meters. The nameplate shall be

mounted on the case so that it will identify the equipment as specified on the drawings. Brass or stainless steel mounting screws shall be used. The nameplate shall be typical for all transmitters, pressure gauges, control stations, valves, actuators, etc.

Engineering unit shall be provided for all scales (0 to 100% shall not be acceptable). For 2 wire transmitters specified, the receiving end shall be provided with a DC power supply with 120V input as required.

Each receiver and each transmitter shall have an individual cutout, switch and/or fuse to disconnect the receiver from all sources of electricity, including both power and signal sources.

Straightening vanes or other required accessories shall be furnished and installed if necessary to meet the accuracy requirements in these Contract Documents.

170000.24 DEVICE AND SIGNAL IDENTIFICATION

All field mounted devices, such as meters, gauges, pumps, valves, controllers, and other equipment, shall be identified with a permanently affixed, embossed stainless steel tag. Characters shall be at least 3/8 inch high and markings shall include a tag number, device or equipment name, and circuit number (where applicable). Tags shall be attached to devices with stainless steel tie wires. The tags shall be compatible with tag description listing for record documents drawings as noted on the Plans.

At all devices, terminal blocks, splices, etc. all wiring and terminals shall be identified with circuit identification markers as described in Section 160112 of these Specifications. This identification shall include a signal tag number and polarity (where applicable). All instrumentation cables shall be tagged at both ends and at any intermediate pullboxes or manholes in which the instrumentation cables are routed through. Tagging requirements shall also apply to all internal and external wiring of all instruments, and control panels.

170000.25 TESTING

All control/instrumentation shall be factory tested and calibrated. Factory test/calibration records shall be submitted to show that the equipment has achieved the specified performance and accuracy. The Contractor shall field test and calibrate all control/instrumentation in accordance with the manufacturer's instructions. Field test/calibration data sheets shall be submitted to show that the equipment has achieved the specified performance and accuracy. Test equipment shall have an accuracy three times better than that of the device under test. Analog devices shall be tested at five point over the full range.

The Contractor shall conduct loop/system acceptance tests proving loop/system integrity and accuracy. Acceptance tests shall be witnessed by the District engineer and data sheets shall be submitted. Unless otherwise specified or listed as an exception in the bid, overall loop/system accuracy (not repeatability, not resolution) shall be within ± 3 percent of the measured/controlled process variable. Where equipment or systems fails to meet the manufacturer's specified performance and accuracy, the Contractor shall provide the services of the manufacturer's field service engineer.

170000.27 TRAINING

The Contractor shall also include in his bid for training of personnel in operation and maintenance of the furnished control systems. Training shall comprise sessions 32 hours for general instrumentation and control systems. A submittal detailing the proposed training program shall be subject to review by the District.

170000.30 INTERCOMPONENT WIRING AND TUBING

Intercomponent wiring shall be run in conduit. Minimum permissible signal wiring insulation voltage is 600 volts, with the exception of special cable as required by the manufacturer and accepted by the Engineer.

Pneumatic systems control tubing and fittings internally used for panels fabrication and externally used for interconnection of components shall be (1/4-inch OD) stainless steel. All tubing and fittings shall be designed and installed for a minimum of 150 psi.

170001.10 INSTRUMENTATION CLASS CABLE

Instrument cable shall have the number of twisted pairs indicated on the Plans and shall be insulated for not less than 600 volts. Unless otherwise indicated, conductor size shall be No. 18 AWG minimum.

The jacket shall be flame retardant Flamenal or Okoseal, 90 degrees C temperature rating. The cable shield shall be a minimum of 2.3 mil aluminum or copper tape overlapped to provide 100 percent coverage and a tinned copper drain wire.

The conductors shall be bare soft annealed copper, Class B, 7-strand minimum concentric lay with Okoseal or Vulkene, 15-mil nominal thickness, nylon jacket, 4-mil nominal thickness, 90-degree-C temperature rating. One conductor within each pair shall be numerically identified.

Pairs shall be assembled with a nominal 2-inch lay and shall then be group shielded with a minimum of 1.3-mil aluminum or copper tape overlapped to provide 100 percent coverage. All group shields shall be completely isolated from each other.

Instrumentation cables shall be installed in separate raceways. This includes through manholes. Instrumentation cable shall be continuous between instruments or between field devices and instrument enclosures. There shall be no intermediate splices or terminal boards.

The instrumentation cable shall be Type TC as manufactured by Okonite, Okoseal - N SP-OS, Belden equivalent, or equal.

170002.10 TERMINATIONS AND SPLICES (600 VOLT AND LESS)

Terminations shall be terminal board type with set-screw pressure connectors. Splicing shall join conductors mechanically and electrically to provide a complete circuit prior to installation of insulation. Conductors, including grounding conductors, of different sizes shall be spliced and then soldered or welded. Splices in wet locations and all splices below grade shall be waterproof heat shrink type as manufactured by Elastimold, Thomas-Betts, or equal.

170003.10 CONDUIT

Conduit shall be as shown on the Plans and as specified in DIVISION 16.

170010 PRIMARY ELEMENTS

170010.10 GENERAL

Primary elements shall be complete and ready for operation. Elements consisting of more than one unit, such as sensor, signal converter, and transmitter, shall include all conductors and conduit furnished and installed to interconnect each component.

170011.21 SOLID STATE RELAYS

The solid state relays shall be of the silicone controlled rectifier type. The self-contained unit shall be for use in controlling liquids having a low specific resistance.

The relays shall be dual voltage, 120/240 volts AC, with silver cadmium oxide contacts rated at 10 amperes at 120 or 240 volts AC, or 28 volts DC. The load contacts shall be two double pole double throw, plus a single pole double throw holding contact. If more contacts are required, an auxiliary relay specified elsewhere shall be provided.

The relays shall be as manufactured by B/W, Warrick Company, or equal.

170011.22 INTRINSICALLY SAFE RELAYS

The intrinsically safe relay shall be Factory Mutual approved for use in Class 1, Divisions 1 and 2, Groups A, B, C, and D hazardous locations. It shall be equipped with a variable resistance potentiometer that permits field adjustment of sensitivity.

The relays shall be dual voltage 120/240 volt AC with contacts rated at 25 amperes at 120 or 240 volts AC or 24 volts DC. The contacts shall be double pole double throw. If more contacts are required, an auxiliary relay specified elsewhere shall be provided.

The relays shall be as manufactured by B/W, Warrick Company, or equal.

170012 MAGNETIC FLOW SENSORS

Magnetic flow sensors shall be installed as required, complete with associated instrumentation, interfaces, cabling, and, as a minimum, shall consist of the following:

General

Pipe size range: DN15 to DN 300 (0.5 in. to 12 in.)

Flow Range

- Minimum: 0.05 m/s (0.15 ft/s)
- Maximum: 10 m/s (33 ft/s)

Linearity: $\pm 1\%$ reading plus 0.01m/s (0.033 ft/s)

Repeatability: $\pm 0.5\%$ of reading @ 25°C
(77°F)

Minimum Conductivity: 20 $\mu\text{S}/\text{cm}$

Wetted Materials:

Sensor body/Electrodes and Grounding ring:

- -P0, -P1, -P2: Polypropylene/316LSS
- -T0, -T1, -T2: PVDF/Titanium
- -V0, -V1, -V2: PVDF/Hastelloy-C
- -W0, -W1, -W2: PVDF/316LSS

O-rings:

- FPM (standard)
- EPDM, Kalrez (optional) Case: PBT

Display Window: Polyamide

Protection rating: NEMA 4X/IP65

Electrical

Power Requirements

- 4 to 20 mA: 21.6 to 26.4 VDC, 22.1 mA max.
- Frequency: 5 to 26.4 VDC, 15 mA max.
- Digital (S3L): 5 to 6.5 VDC, 15 mA max.
- Auxiliary (only required for units with relays): 9 to 24 VDC, 0.4A max Reverse polarity and short circuit protected

Current output (4 to 20 mA):

- Loop Accuracy: 32 μ A max. error (25°C @ 24 VDC)
- Isolation: Low voltage < 48 VAC/DC from electrodes and auxiliary power
- Maximum cable: 300 m (1000 ft.)
- Error condition: 22.1 mA
- Max. Loop Resistance: 300 Ω
- Compatible with PLC, PC or similar equipment
- 4 to 20 min. load needed

Frequency output:

- Output modes: Freq., or Mirror Relay
- Max. Pull-up Voltage: 30 VDC
- Max. Current Sink: 50 mA, current limited
- Maximum cable: 300 m (1000 ft.)
- Compatible with Signet Model 5075, 5500, 5600, 8550, 8900

Digital (S3L) Output:

- Serial ASCII, TTL level 9600 bps
- Compatible with Model Signet 8900 instrument

Relay Specifications

- #1, #2 Type: Mechanical SPDT Rating: 5A @ 30 VDC max., 5A @ 250 VDC max.
- #3 Type: Solid State Rating: 50mA @ 30 VDC, 50mA @ 42 VAC

Hysteresis:

- User adjustable, plus timer delay

Trigger Delay:

- Adjustable (0 to 9999.9 sec.)

Relay Modes:

- Off, Low, High, Window, and Proportional Pulse

Relay Source:

- Flow Rate, Resettable Totalizer

Error Condition:

- Selectable; Fail Open or Closed

Display

Characters: 2 x 16

Contrast: User-set in four levels Backlighting (only on relay versions):

Requires external 9-24 VDC, 0.4 mA max.

Max. Pressure/Temperature Ratings

Storage Temperature:

- -20° to 70°C (-4° to 158°F)

Relative Humidity :

- 0 to 95% (non-condensing)

Operating Temperature

- Ambient: -10° to 70°C (14° to 158°F)

- Media: 0° to 85°C (32° to 185°F)

Maximum operating pressure:

- 10.3 bar @ 25°C (150 psi @ 77°F)

- 1.4 bar @ 85°C (20 psi @ 185°F)

170012.11 MAGNETIC FLOW METERS

Magnetic flow meters shall be ultra-high impedance pulsed DC type constructed with neoprene liners, bullet nose Type 316 stainless steel electrodes, suitable for intended use. No ultrasonic cleaning shall be required.

Unless otherwise indicated on Plans, the power supply to the meters shall be 120 volts, 60Hertz with 4-20 mA output. It shall be installed in accordance with DIVISION 16 of these Contract Documents and in conformity with the recommendations of the manufacturer of the meter.

The meters shall be splash-proof and shall be able to withstand accidental submergence in water. The electrodes shall be field replaceable without affecting calibration.

The output of the meter shall be linear and directly proportional to the average velocity of the fluid flowing through the meter tube. Neither turbulence nor variation in velocity profile within the flowing fluid shall affect the accuracy of the transmitter in its ability to measure the average flow. The meter shall also not be affected by a concentric buildup of slime which has the same conductivity as the flowing fluid.

Meter sizes and calibrations shall be as shown on Plans and/or elsewhere in these Contract Documents. The meters shall be rated for 150 lbs or 250 lbs as indicated on the plans.

For full bore type meters, the calibrated accuracy of the entire system, including readout, shall not be less than plus or minus 0.5 percent of maximum flow for all metered velocities between 3 and 30 feet per second. The meter shall give no "ghost readings" under a condition of zero flow. The repeatability of the scale reading shall not be less than 0.5 percent of full scale reading and shall not be affected by fluctuations of line voltages of plus or minus 10 percent or frequency of plus or minus 1 percent.

For insertion type meters, the calibrated accuracy of the entire system, including readout, shall not be less than plus or minus 2 percent of maximum flow for all metered velocities between 3 and 30 feet per second. The repeatability of the scale reading shall not be less than 0.3 percent of full scale reading and shall not be affected by fluctuations of line voltages of plus or minus 10 percent or frequency of plus or minus 1 percent.

The 4-20 mA output signal on the meter shall be compatible with standard PLC analog inputs. The flow meter indicator shall have a local and remote indicator/transmitter with 4-20 mA output to the RTU terminal strip. See plans for locations of these devices to determine the length of cables required.

The flow meters shall be McCrometer FPI Mag Meters Model 395 with 2" stainless steel full port isolation lever valve or equal. Shall include sensor top plate and specialized sensor installation tool. Shall include remote mount LCD display and adequate wiring to reach control panel.

Insertion Mag Meter Accuracy: $\pm 0.5\%$ from 1 ft/s to 32 ft/s (0.3 m/s to 10 m/s)
 $\pm 1\%$ from 0.3 ft/s to 1 ft/s (0.1 m/s to 0.3 m/s)

Body material: 316 Stainless Steel Sensor Body, Insertion Hardware and Sensor Electrodes NSF Certified 3M Fusion-Bonded Epoxy Coating

Line size: 4 to 138" (100 mm to 3,500 mm)

Range: 0.3 ft/s - 32 ft/s (0.1 m/s - 10 m/s)

Repeatability: 0.3% of reading

The manufacturer shall have had a meter of the same design and similar size continuously metering like fluid for a period of time to the satisfaction of the Engineer.

170013 ULTRASONIC

The ultrasonic sensors shall be of the non-contact type for continuous measurement of liquid level. Unit shall include a front panel mounted level or flow indicating meter and shall provide a 4-20 mA DC analog output signal which is proportional to liquid level and a scaled pulse output for remote totalization.

The 4-20 mA output signal on the level sensor shall be compatible with standard PLC analog inputs. The level indicator shall have a local and remote indicator/transmitter with 4-20 mA output to the RTU terminal strip. See plans for locations of these devices to determine the length of cables required.

The system shall be variable span 0-4 inches to 0 to 20 feet. The span and range shall be easily set in the field. No external calibration equipment shall be required.

All electronic controls shall be in a NEMA 4 or NEMA 4X enclosure.

The system shall operate on 120 V AC and shall be as manufactured by ABB, Siemens, Endress-Hausser, or equal. If required for calibration one calibrator shall be supplied.

170100 TRANSMITTERS

170101.10 PRESSURE TRANSMITTERS (DC CURRENT)

Electronic pressure transmitters shall be furnished and installed as required. They shall produce an output of 4-20 mA DC in 0 to 500 ohm loads. They shall have the minimum following characteristics:

Accuracy	plus or minus 0.5 percent of span
Repeatability	0.2 percent of span
Dead Band:	0.1 percent of span

They shall have an external zero adjustment, and be of the two-wire design, requiring no power supply at the device.

Unless specified otherwise on the Plans or elsewhere in these Contract Documents, they shall be in NEMA 4 enclosures, with die-cast aluminum body and fiberglass reinforced polyester resin cover. Their wetted parts shall be Type 316 stainless steel.

Where called for in the Plans or elsewhere in these Contract Documents, they shall be of the intrinsically safe design. A four wire pressure transmitter will be acceptable.

Pressure transmitters shall be Endress-Hausser Cerabar PMC71-ABC1S6RDBAA, or equal.

170102.10 DIFFERENTIAL PRESSURE TRANSMITTERS (PNEUMATIC)

Pneumatic differential pressure transmitter shall be non-indicating, force balance type differential pressure transmitter, and shall have zero and span adjustments, and provide for suppression and elevation. Accuracy shall be within plus or minus 0.5 percent of span. The transmitter shall operate with a supply pressure of 20 psig, and shall output a 3-15 pressure signal proportional to the span specified. The transmitter shall be provided in a NEMA 4 enclosure suitable for wall, floor stand, or flange mounting.

170103.10 DIFFERENTIAL PRESSURE (ELECTRONIC)

Electronic differential pressure transmitters shall be of the force balance type, and shall have zero and span adjustment. Transmitters shall transmit a 4-20 mA DC signal proportional to the differential pressure span specified. Accuracy shall be within plus or minus .25 percent of span. Transmitters shall be provided in a NEMA 4 enclosure, suitable for wall, floor stand, or flange mounting.

Transmitters shall be ABB, Endress-Hausser, or equal.

170200 SIGNAL CONVERTERS

170201.10 PRESSURE-TO-CURRENT TRANSDUCER

The pressure-to-current transducer shall produce a 4-20 mA DC output signal with a 3-15 psig input. Its accuracy shall be plus or minus 0.5 percent of span or better and its operating temperature range shall be from minus 20 degrees F to 180 degrees F. Its body shall be die-cast aluminum, with fully gasketed cover. Its wetted parts shall be stainless steel. It shall be of the two-wire design requiring no power supply in the field.

170201.20 CURRENT-TO-CURRENT CONVERTER

Current-to-current converters shall provide electrical isolation between the input and output. Current-to-current converters shall be supplied where shown and wherever the circuit impedance exceeds the capability of a transmitter. The converter shall receive a 4-20 mA DC analog current input signal and produce an identical 4-20 mA DC output signal into a 0-1,000 ohm load. Accuracy shall be plus or minus 0.25 percent of span. The converter shall be provided with NEMA 12 enclosure suitable for back of panel mounting.

170306.10 SQUARE ROOT EXTRACTORS

Electronic square root extractors shall be provided as required. They shall be suitable to accept an input of 4-20 mA DC and shall be powered by 120 volts AC, 60 Hertz. They shall produce an output of 4-20 mA DC into a load of up to 500 ohms. Their calibrated accuracy shall be plus or minus 0.5 percent between

10 percent and 100 percent of full scale and plus or minus 0.2 percent full scale between 0 and 10 percent of full scale.

The connections shall be brought to a barrier type terminal board and the housing shall be a steel case with slide-out chassis.

They shall be Fischer & Porter, Foxboro, or equal.

170307.10 TOTALIZERS (GENERAL)

Totalizers shall be seven or more digit type, reading directly in the units required without the use of a multiplier, except for the addition of ciphers. If ciphers must be added, this shall be so indicated on a permanent lamicoid nameplate that is visible from the outside.

They shall be Fischer & Porter, Foxboro, or equal.

170307.11 TOTALIZERS (INTEGRATORS)

Electronic totalizers (integrators) shall be furnished and installed as required. They shall be suitable to accept an input of 4-20 mA DC and shall be powered by 120 volts AC, 60 Hertz. They shall be linear or square root type, as called for on the Plans or elsewhere in these Contract Documents. Their count rate shall be adjustable from 200 to 25,000 counts per hour and their output shall be displayed on an electro-mechanical counter. Their calibrated accuracy shall be as follows:

Linear plus or minus 0.5 percent of rate when operating above 10 percent full scale.

Square Root plus or minus 0.5 percent of rate when operating above 25 percent full scale.

The connections shall be brought to a barrier type terminal board and the housing shall be a steel case with slide-out chassis.

170307.12 TOTALIZERS (PULSE COUNTERS)

Totalizers (pulse count type) shall be of the same overall construction as the totalizers (integrators).

170312.10 ELECTRONIC 4-20 MA INDICATORS

Electronic indicators shall be provided as required for 4-20 mA process variable. Their input impedance shall be 5 ohms maximum, their accuracy plus or minus 2 percent and power requirements 120 volts AC, plus or minus 10 percent, 60 Hertz.

They shall be supplied with appropriate range and units of measurement to indicate actual conditions. Zero to 100 percent or 4-20 mA DC is not acceptable. A front mounted screw for zero adjust shall be provided.

Panel mounted indicators shall be flush mounted and other indicators shall be in NEMA 4 enclosures with the indicating dial fully exposed.

They shall be ABB, Endress-Hauser, or equal.

170312.11 DIGITAL ELECTRONIC 4-20MA DC INDICATORS

Digital indicators shall be provided as required for 4-20 mA DC input signal. They shall have 5 ohms impedance maximum with plus or minus 2 percent accuracy. Power input shall be 120 volt. They shall have five segment planner LED minimum or as required by process variable indication. They shall be Doric Scientific, Electro Industry, or equal.

170313.10 DIFFERENTIAL PRESSURE INDICATORS

Where the flow signal is not to be transmitted or totalized, and only a local flow indication is called for, a differential pressure gauge of the proper range to give a full-scale indication at maximum flow shall be supplied. The scale shall be of the square root type and calibrated in actual units of flow. Gauges shall be Dwyer, Ameter, or equal.

170314.10 SET POINT RELAYS

The set point relays shall be solid state device and shall provide a contact closure or opening output from a 4-20 mA current input upon reaching a preselected set point. The set point shall be continuously adjustable over the entire span. The dead band shall also be adjustable from at least 1 percent to 20 percent. The output relay shall be DPDT with contacts rated 5 amps at 120 volts AC resistive load. The output contacts shall be isolated. Power requirements shall be 120 volts AC, 60 Hertz.

The unit shall be housed in a general purpose, dead front, type housing.

The set point relays shall be AGM, Fischer & Porter Type 55PA, Foxboro 63 Series, or equal.

170405.10 CONTROL PANELS

Control panel(s), unless otherwise indicated, shall be vertical rack type with full length hinged doors to open as shown on the Plans. The panel dimensions shall be as indicated on the Plans and as required for the equipment furnished. Sufficient working space shall be provided around all installed equipment. The panels shall be formed of not less than 10-gauge cold-rolled steel. The framework shall be made of not less than 2-inch by 2-inch by 3/16-inch thick steel angle.

The control panels shall be furnished, designed, shop painted, assembled and wired, shop tested, field tested, and placed in satisfactory operation by the supplier and major manufacturer of the instrumentation equipment.

The panels shall be complete with instruments, meters, switches, controls, indicating lights, wires, wireways, grounding, nameplates, and all other accessories and appurtenances required for complete panels. The controls and components to be included on the panels are as shown.

The following drawings of each panel shall be supplied by the panel manufacturer for acceptance before fabrication:

- A. Panel front view showing equipment arrangement and dimensional information.
- B. Panel floor plan and side view showing dimensions, doors, and equipment layout inside the panel.
- C. Drawing showing structural details.

- D. Diagrams showing all external devices connected to the panel.
- E. Wiring diagrams.
- F. Panel bill of material with detailed description of components.

Instruments shall be securely braced and secured by a supporting framework such that a minimum load is put on the panel face.

Joints shall be welded and ground smooth. All hardware shall be non-corrodible metal. All anchor bolts, nuts, and washers required for secure anchorage to steel channel bases shall be provided. Panel enclosures shall be shipped with nameplates mounted, and all equipment mounted and wired.

The exterior of the panels shall be selected by the Engineer and the interior shall be white. Both finishes shall be applied over bonderizing.

The fabrication of the enclosures shall be subject to the Engineer's acceptance. Proposed panel layouts are, in general, shown on the Plans; however, these shall be modified as required to facilitate equipment furnished. Enclosures shall be NEMA 1 gasketed or as indicated on the Plans.

All punching, reaming, cutting, and other fabricating work shall be done before the finish is applied. All electrical connections shall terminate at terminal strips, which shall be labeled with appropriate identifying data. All terminal strips shall be provided with a minimum of 25 percent spare terminals. Panels shall be delivered with all instruments and controls installed and completely wired and piped. Panels shall be shipped with complete wiring and piping diagrams and instructions to identify instrumentation inside the panel, as well as internal wiring and piping diagrams.

Each device requiring power or neutral connection shall be arranged so that when the wires are removed from any unit, no other shall be interfered with.

All electrical wiring within the panels shall be color coded, bundled, and bound with plastic strip lock straps and terminated on numbered terminal strips. All external connections shall be properly identified by function and number in accordance with ISA standards. Power to the panel shall be 120 volts, 60 Hertz, single phase. The panel shall be provided with a 20A 125V receptacle, a fluorescent fixture provided with wire guard and a switch.

If the instruments are series wired, only one receiver in the loop shall be grounded while the others shall accept a floating input. Also, current-to-current converters shall be provided as required for load boosting in order to accommodate the appropriate number of instruments. If the instruments are parallel wired, all receivers shall be referenced to the same common.

All signal connections for outgoing 4-20 mA DC signals shall be equipped with adequate signal retransmission devices. For parallel wired systems, voltage-to-current transducers shall be provided and shall be referenced to the same common as all other receiving instruments. For series wired systems, fully isolated current-to-current transducers shall be provided to maintain loop continuity and eliminate grounding problems.

All lights, instruments, push buttons, and other equipment mounted in or on the panels shall have engraved identification and function nameplates. The nameplates shall be black lamicoic plastic with white letters

and shall be fastened with round head brass screws. Equipment mounted inside the panels shall be labeled with identification which correlates with Plan identification.

171000 OWNER SUPPLIED EQUIPMENT

The following equipment will be provided by the Owner for this project:

1. Programming Language Controller (for booster pump station programming & combining signals from tank & pump stations)
2. Network Switch
3. 12" HMI touchscreen

The Owner provided PLC shall be installed by the contractor with all conduits stubbed into the cabinet and adequate wire to reach any point in the instrumentation cabinet coiled up and labeled.

The touch screen shall be installed on the instrumentation cabinet door. All communication/data link wire and termination shall be provided and installed by the Contractor including, RS-485 Mod Bus Communication, Cat 6e wire, grounding, and shielding. The Contractor shall terminate all digital and analog inputs and outputs on a terminal strip. Wiring between the MCC and the terminal strip shall be by the contractor but coordinated with the Owner. All wiring, conduit and termination of field devices will be completed by the contractor.

Programming of the PLC will be by the Owner. The Contractor shall coordinate with the Owner during startup.

172000 CONTROL NARRATIVE (FOR OWNER PROGRAMMING)

The following narrative is provided for owner convenience to assist in programming of the PLC for the booster pump station.

Input signals (local to booster pump station)

1. Supply pressure (suction header in booster pump station vault)
2. Booster Pump #1 (start, in auto, status, alarm, temp, amperage, rtm)
3. Booster Pump #2 (start, in auto, status, alarm, temp, amperage, rtm)
4. Booster Pump #3 (start, in auto, status, alarm, temp, amperage, rtm)
5. Booster Pump #4 (start, in auto, status, alarm, temp, amperage, rtm)
6. Discharge pressure (discharge header in booster pump station)
7. Booster Pump Station Flow (booster pump station)
8. Flow control valve solenoid override
9. High temperature sensor/ alarm (booster pump station)
10. Vault Flood switch (booster pump station vault)
11. Booster Pump Station Flood switch (booster pump station)
12. Back-up generator running contact (ATS at booster pump station exterior)
13. Tank inlet chlorine analyzer
14. Tank outlet chlorine analyzer

Input signals (remote but needed for booster pump station programming)

1. Well #10 Pump (start, in auto, status)

2. Heritage 10 MG tank level
3. Orem central zone tank level
4. Orem central zone master meter flow
5. Central zone pressure – located

General Programming Notes

1. Logic must limit starting of booster pumps to one at a time
2. Pumps must be set up with minimum runtime and/ or start delay protection so that the maximum recommended starts per hour are not exceeded (time delay relay shall be integral to pump control panels, also)
3. Pumps shall be sequenced to rotate through which pump starts up first to ensure even usage and wear and tear
4. Pump operation during back-up power generator shall be limited to the following:
 - a. Deep well pump and one booster pump or
 - b. Two booster pumps
 - i. Booster pump control panels will include a contactor to facilitate this requirement
5. Security functions will be done in a separate security panel provided by the security contractor. Signals from security devices may be terminated on terminal strip in instrumentation cabinet and then passed on to the security panel.

Booster Pump Operation – Start-up

All start-up conditions require the following:

1. Heritage 10 MG tank level is above absolute minimum elevation (NPSHr for booster pumps or minimum safe level to avoid any booster pump running dry, whichever is greater)
2. Booster pump station high discharge pressure alarm or low intake pressure alarm are not active
3. Booster pump station high temperature alarm is not active
4. Booster pump alarm is not active

Condition #1

1. Central zone tank reaches elevation minimum
2. All booster pumps are off
3. Heritage 10 MG tank is above normal minimum elevation

Condition #2

1. Orem Central Zone pressure drops below 90 PSI
2. All booster pumps are off

Condition #3

1. Orem Central Zone master meter exceeds 10,000 GPM
2. All booster pumps are off

Condition #4

1. Orem Central Zone master meter exceeds 12,000 GPM
2. One booster pump is running
3. Heritage 10 MG tank is above normal minimum elevation
4. Manual override to maintain supply to CUWCD central zone is not active

Condition #5

1. Orem Central Zone master meter exceeds 12,000 GPM
2. One booster pump is running
3. Manual override to maintain supply to CUWCD central zone is active

Condition #6

1. Orem Central Zone pressure remains below 90 PSI
2. One or more booster pumps are running
 - a. Continue starting each booster pump in sequence until all four are running

Booster Pump Operation – Shut-down

Condition #1

1. Central zone pressure reaches 120 psi (or other pressure set point)
2. Central zone master meter is below 10,000 GPM
3. Central zone tank is at maximum elevation
4. Shut booster pumps off in staged sequence as conditions remain

Condition #2

1. Heritage 10 MG tank level reaches normal minimum elevation (siphon elevation)
2. Central zone master meter is below 10,000 GPM
3. Manual override to maintain supply to CUWCD central zone is not active
4. Shut booster pumps off in staged sequence as conditions remain

Condition #3

1. Heritage 10 MG tank level reaches absolute minimum elevation
2. Manual override to maintain supply to CUWCD central zone is active
3. Shut booster pumps off in staged sequence

Condition #4

1. Central zone pressure reaches 140 psi (or other high pressure set point)
2. Shut booster pumps off in staged sequence as conditions remain

Condition #5

1. Booster pump station discharge pressure reaches high discharge pressure set point (high pressure alarm)
2. Shut booster pumps off in staged sequence as conditions remain

Condition #6

1. Booster pump station inlet pressure drops below low pressure set point (low pressure alarm)
2. Shut booster pumps off in staged sequence as conditions remain

Flow Control Valve controls/ information:

1. 13,500 GPM max flow through this valve
2. 120 PSI maximum pressure drop through FCV
3. FCV cannot turn on when booster pumps are on.
 - a. Solenoid override valve will facilitate this requirement
4. FCV must turn off when Heritage 10 MG tank is full.
 - a. Solenoid override valve will facilitate this requirement
5. FCV cannot turn on when central zone pressure is below set-point for booster pump shut-down with buffer to avoid cycling (wasting energy)
 - a. FCV setpoint will maintain this requirement
6. Tank minimum water level being reached must turn the FCV on unless overridden manually by the solenoid

*** END OF DIVISION 17 ***

DIVISION 32

MANUFACTURED METAL BOLLARDS



SECTION 323913.11: Manufactured Metal Security Bollards - Fixed Security Bollards

PART 1 - GENERAL

1.1 CONDITIONS AND REQUIREMENTS

- A. The General Conditions, Supplementary Conditions, and Division 1 – General Requirements apply.

1.2 SECTION INCLUDES

- A. Section 32 39 13.11 - Manufactured Metal Security Bollards of the following types:
 - 1. 5-inch Security Bollards.

1.3 RELATED SECTIONS

- A. Section 05 50 00 – Metal Fabrications.

1.4 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated, Welded and Seamless.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data:
 - 1. Manufacturer's printed product literature, specifications, and data sheet.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance and service instructions.
- C. Shop Drawings: Submit installation drawings indicating bollard locations, materials, dimensions, weights, sizes, and finishes. Include plans, elevations, sections, foundation drawings, and details of anchorage.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Storage and Protection: Store bollards indoors until installation to protect from weather.

1.7 SEQUENCING AND SCHEDULING

- A. Sequencing and Scheduling, General: Refer to sequence requirements specified in Section 01 11 00 - Summary of Work and Section 01 32 16 - Construction Progress Schedule requirements specified in Section 01 33 00 - Submittals Procedures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Specified Manufacturer: 1-800-Bollards, 23392 Madero Road, Suite L, Mission Viejo, CA, 92691-2737, 1-866-748-4676. Email: info@1800bollards.com; Web: www.1800bollards.com.
- B. Requests for substitutions will be considered in accordance with provisions specified in Section 01 62 00 – Product Options.

2.2 MATERIALS

- A. 5-inch Security Bollards.
 1. Footing: Fixed.
 2. Height: 36 Inches.
 3. Material: Stainless steel: Schedule 40.
 4. Depth for Fixed footing bollards: 12 inches
 5. Pipe diameter: 5 inches.
 6. Outside diameter: Fixed stainless steel: 5.56 inches
 7. Wall thickness: 0.258 inches
 8. Cap style: Dome.
 9. Security level: Medium.

2.3 FINISH

- A. Stainless steel type 304, polished to a #4 satin finish.

2.4 ACCESSORIES

- A. Bollard covers.
 1. Plastic bollard covers.
 2. Stainless steel bollard covers.
- B. Chain eyes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project conditions and completed Work with Installer present and verify compliance for level finished grade, mounting surfaces, installation tolerances, and other conditions impacting performance of the Work.
- B. Immediately correct all deficiencies and conditions which would cause improper execution of Work specified in this Section and subsequent Work.

- C. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation.
- D. Proceeding with Work specified in this Section shall be interpreted to mean that all conditions were determined to be acceptable prior to start of Work.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation. Ensure all surfaces are clear of dirt and debris.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Store bollards indoors until installation to protect from weather.

3.3 INSTALLATION

- A. Install 1-800-Bollards Security Bollards in accordance with manufacturers instructions and recommendations and the authorities having jurisdiction.
- B. Ensure all bollard equipment to be installed is located at the site.
- C. Install in accordance with approved submittals and in proper relationship with adjacent construction.
- D. Protect all surfaces from debris, dirt, and concrete pour during installation.
- E. Install 1-800-Bollards Security Bollards level and plumb.
- F. Anchor bollards securely.

3.4 PROTECTION AND MAINTENANCE

- A. Protection, General: In addition to general requirements specified in Section 01 50 00 – Temporary Facilities and Controls, 01 54 00 – Construction Aids, Section 01 56 00 – Temporary Barriers and Enclosures, Section 01 60 00 – Product Requirements, and Section 01 77 00 – Closeout Procedures, comply also with the following requirements.
 - 1. Protect installed products until completion of the project.
 - 2. Protect adjacent work areas and finish surfaces from damage during product installation.
 - 3. Clean products in accordance with the manufacturer's recommendations.
 - 4. Touch-up, repair, or replace damage products prior to Substantial Completion.
- B. Maintenance: Wipe down stainless-steel bollards at least once per month to remove oxidants.

SECTION 323913: Manufactured Metal Bollards - Removable Bollards

PART 1 - GENERAL

1.1 CONDITIONS AND REQUIREMENTS

- A. The General Conditions, Supplementary Conditions, and Division 01 – General Requirements apply.

1.1 SECTION INCLUDES

- A. Section 32 39 13 – Manufactured Metal Bollards: Removable Manufactured Metal Bollards of the following types:
 - 1. 5 inch Removable Schedule 40.
 - 2. Embedment Sleeve for Removable Bollards.

1.2 RELATED SECTIONS

- A. Section 05 50 00 – Metal Fabrications.

1.3 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated, Welded and Seamless.

1.4 SUBMITTALS

- A. Submit under provisions of Section 013000 - Administrative Requirements.
 - B. Product Data:
 - 1. Manufacturer's printed product literature, specifications, and data sheet.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance and service instructions.
 - C. Shop Drawings: Submit installation drawings indicating bollard locations, materials, dimensions, weights, sizes, and finishes. Include plans, elevations, sections, foundation drawings, and details of anchorage.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Storage and Protection: Store bollards indoors until installation to protect from weather.

1.6 SEQUENCING AND SCHEDULING

- A. Sequencing and Scheduling, General: Refer to sequence requirements specified in Section 01 11 00 - Summary of Work and Section 01 32 16 - Construction Progress Schedule requirements specified in Section 01 33 00 - Submittals Procedures.

PART 2 - PRODUCTS

2.2 MANUFACTURERS

- A. Specified Manufacturer: 1-800-Bollards, 23392 Madero Road, Suite L, Mission Viejo, CA, 92691-2737, 1-866-748-4676. Email: info@1800bollards.com; Web: www.1800bollards.com.
- B. Requests for substitutions will be considered in accordance with provisions specified in Section 01 62 00 – Product Options.

2.3 MATERIALS

- A. 5 inch Removable Schedule 40 Bollards.
 - 1. Lock type: Padlock Removable or Internal Locking (OWNER APPROVAL REQ.).
 - 2. Height: 36 inches.
 - 3. Depth: 12 inches.
 - 4. Pipe diameter: 5 inches.
 - 5. Material: Stainless steel Type 304: Schedule 40.
 - 6. Outside diameter: 5.56 inches.
 - 7. Wall thickness 0.258 inches.
 - 8. Security level: Medium.
 - 9. Weight: 59 pounds.
 - 10. Cap style: Dome.
- B. Embedment Sleeve for Removable Bollards.
 - 1. Size: 5 inch.
 - 2. Material: Type 304 stainless steel with attached lid. The lid will lock down when the bollard is removed.
 - 3. Lock: Inside embedment sleeve, underground.

2.4 FINISH

- A. Stainless steel type 304, polished to a #4 satin finish.

2.5 ACCESSORIES

- A. Storage sleeves.
- B. Chain eyes.

EXECUTION

3.5 EXAMINATION

- A. Examine Project conditions and completed Work with Installer present and verify compliance for level finished grade, mounting surfaces, installation tolerances, and other conditions impacting performance of the Work.
- B. Immediately correct all deficiencies and conditions which would cause improper execution of Work specified in this Section and subsequent Work.

- C. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation.
- D. Proceeding with Work specified in this Section shall be interpreted to mean that all conditions were determined to be acceptable prior to start of Work.

3.6 PREPARATION

- A. Clean surfaces thoroughly prior to installation. Ensure all surfaces are clear of dirt and debris.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Store bollards indoors until installation to protect from weather.

3.7 INSTALLATION

- A. Install 1-800-Bollards Removable Bollards in accordance with manufacturers instructions and recommendations and the authorities having jurisdiction.
- B. Ensure all bollard equipment to be installed is located at the site.
- C. Install in accordance with approved submittals and in proper relationship with adjacent construction.
- D. Protect all surfaces from debris, dirt, and concrete pour during installation.
- E. Install 1-800-Bollards Removable Bollards level and plumb.
- F. Anchor bollards securely.

3.8 PROTECTION AND MAINTENANCE

- A. Protection, General: In addition to general requirements specified in Section [01 50 00 – Temporary Facilities and Controls,] [01 54 00 – Construction Aids,] [Section 01 56 00 – Temporary Barriers and Enclosures,] [Section 01 60 00 – Product Requirements], and [Section 01 77 00 – Closeout Procedures], comply also with the following requirements.
 - 1. Store bollards indoors until installation to protect from weather.
 - 2. Protect installed products until completion of the project.
 - 3. Protect adjacent work areas and finish surfaces from damage during product installation.
 - 4. Clean products in accordance with the manufacturer's recommendations.
 - 5. Touch-up, repair, or replace damage products prior to Substantial Completion.
- B. Maintenance: Wipe down stainless-steel bollards at least once per month to remove oxidants.

END OF SECTION 13