Bid No.: CC22-420-RE
(Show this number on envelope)

Riverton City Purchasing

12830 South Redwood Rd * Riverton, Utah 84065

INVITATION FOR BID

BEFORE REPLYING TO THIS BID PLEASE READ THE INSTRUCTIONS AND GENERAL PROVISIONS PROVIDED WITH THIS DOCUMENT

REPLIES MUST BE LEGIBLE

Company: _____ Fed. ID No. _____

Legal Status: Sole Proprietor Non-Profit Corp. Profit Corp. Partnership Gov.

Ordering Address: _____

_____ Contact Person: _____

Department: _____ Phone: _____ Fax: _____

Requisition Number: **156251** E-Mail: _____

Inquiries Sent To: **Craig Calvert** Remit Address: _____

E-Mail: ccalvert@rivertoncity.com _____ Price Guaranteed Until - Date: _____

Phone: **801-208-3175** Date Sent: 1/27/2023 Payment Terms: _____ Shipment will be made _____ A.R.O.

1. The item(s) specified on this bid are produced, mined, grown, manufactured, or performed in Utah? Yes ☐ No ☐
   IF **No** then where produced, etc.: _____
2. bids must include manufacturer's descriptive literature & F.O.B. origin and destination freight cost or freight allowed or they may be rejected.
3. ***Terms of shipment for F.O.B. origin means: Shipper load, carrier count and stow, consignee unload, freight collect!***

RETURN BID TO:
Riverton City
Attn: Purchasing
12830 S Redwood Rd
Riverton, Utah 84065
Email: bid.submittal@rivertoncity.com

Note: Bids will be opened an read publicly at:

2:00 PM On 2/14/23

THE BID NUMBER LISTED IN THE UPPER RIGHT-HAND CORNER OF THIS DOCUMENT MUST BE REFERENCED WHEN RETURNED.

Visit the Riverton City Home Page at: www.rivertoncity.com

FREIGHT INFORMATION:

Shipping point and zip code: _____

National Motor Freight Classification: _____

Shipping Weight: _____

Item(s) and Specifications	Quantity	Unit	Net Unit Price	Extended Price
Re-Bid for the 13400 South Filter Bank Project. As per attached:				

Total Price, without freight (FOB Origin) $ _____-

Total Price, with freight (FOB Destination) $ _____-

Receipt of addendum acknowledgement. Addendum # 1___2___3___4___5___6___

The undersigned certifies that the vendor is willing and able to furnish the item(s) specified on this bid!

Vendors Authorized Agent: type or print NAME and TITLE) _____

Signature: _____ Date: _____

Please SIGN IN INK or this bid may be rejected, Your signature indicates you have read and agreed to the Instructions & General Provisions.

RIVERTON
UTAH

Specifications and
Contract Documents for

13400 SOUTH CANAL FILTER BANK RE-BID

January 2023

epic ENGINEERING

CONTRACT DOCUMENTS
AND SPECIFICATIONS FOR

13400 South Canal Filter Bank
Re-bid

January 2023

RIVERTON CITY

Project Manager

Signed _____

Michael D. Hartvigsen
Utah P.E. No. 10269777-2202

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

RIVERTON CITY

13400 SOUTH CANAL FILTER BANK

TABLE OF CONTENTS

CONTRACT DOCUMENTS:

GENERAL CONDITIONS:

SPECIAL CONDITIONS AND TECHNICAL SPECIFICATIONS:

Riverton City
Invitation for Bid CC22-420-RE
13400 South Filter Bank Project

Riverton City is conducting an Invitation for Bid for the 13400 South Filter Bank Project. Work includes replacement of two 20-inch secondary water pipe sections spanning the Utah and Salt Lake Canal at 13400 South. The project will include installing 4 new owner provided Amiad filters, new pipe and fittings.

Sealed bids will be due by 2:00 pm on February 14, 2023, and may be turned in at the Purchasing Office, located at 12830 South 1700 West, Riverton, Utah 84065, or may be submitted electronically at bid.submittal@rivertoncity.com. Bids submitted after this time will not be accepted. Bids will be opened and read aloud at approximately 2:01 pm. Bidders registered on the plan holder's list, may request to attend the opening via Zoom meeting by sending a request to the purchasing department, ccalvert@rivertonutah.gov.

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 bid.

An electronic format of the bid package may be obtained through the purchasing website after Wednesday January 4, 2023 https://www.rivertonutah.gov/purchasing/solicitations.php.

INFORMATION FOR BIDDERS

SECURING DOCUMENTS

Electronic copies of the Contract Documents, Specifications and Plans will be available on Friday, January 27, 2023 through the purchasing website at the following link:

https://www.rivertonutah.gov/purchasing/solicitations.php

Hard copies of the Contract Documents, Specifications and Plans may be procured from the office of EPIC ENGINEERING, P.C., 3341 South 4000 West, West Valley City, Utah 84120, telephone (801) 955-5605 starting on Friday, January 27, 2023, at a cost of fifty dollars ($50.00) a set, which is non-refundable.

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.

NO BOOK OF CONTRACT DOCUMENTS SHALL BE DISASSEMBLED

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.

Bids shall be delivered to Riverton City on or before the day and hour set for the opening of bids in the Notice Inviting Bids as published. Bids shall be enclosed in a sealed envelope bearing the title of the work and the name of the bidder. It is the SOLE responsibility of the bidder to see that his bid is received in proper time. Any bids received after the scheduled closing time for receipt of bids will be returned to the bidder unopened.

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 Statement.

Each bidder shall submit with his bid a statement setting forth his experience.

In this statement, the bidder shall include similar projects that he has constructed, showing total project costs when constructed and the names, addresses, phone numbers and contact person of the Owners.

Submit evidence at the time of bid that they have performed three projects of similar type, size, and complexity of this project within the last four years.

Financial Statement.

The Owner may require that bidders under consideration for award of the contract submit a financial statement.

Such statement shall be in a form and substance similar or equal to the form furnished by the Associated General Contractors.

The financial statement shall be submitted within five days of receipt of the request from the Owner.

If bidder fails to submit the financial statement, or if the financial statement is not satisfactory to the Owner, the proposal of such bidder shall be considered nonresponsive, and such proposal may be rejected by the Owner.

COMPETENCY OF BIDDERS

In selecting the lowest responsible bidder, consideration will be given to the general competency of the bidder for the performance of the work covered by the bid. To this end, each bid shall be supported by a statement of the bidder's experience as of recent date on the form entitled "INFORMATION REQUIRED OF BIDDER", bound herein. 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.

No contract award will be made to a Contractor whose firm and Project Superintendent have not satisfactorily completed at least three (3) projects of similar type, complexity and comparable value and whose firm and Project Superintendent have not been in the contracting business for similar work for at least five (5) years. In addition, the Project Superintendent meeting this experience criteria shall be

dedicated to the project. 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.

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.

Award of Bid Schedule "B", Crane Framework, is subject to funding approval by City officials. These approvals have not yet been received and may require a later award date than Bid Schedule "A". Any changes to the scope of work resulting from these approvals will be negotiated with the lowest responsible bidder prior to award.

The award, if made, will be within 90 days after the opening of bids.

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 (5) sets of Plans and Specifications for this project at no extra cost.

If he desires more than the five (5) 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 Winter/Spring of 2023.

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 **April 1, 2023**.

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.

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.

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: Michael Hartvigsen, P.E.

Neither the Engineer nor Riverton 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: Riverton City
Date: _____

Riverton City
12830 South 1700 West
Riverton City, UT 84065

In compliance with your invitation for bids and all conditions of the Contract Documents for the construction of the 13400 SOUTH CANAL FILTER BANK, the undersigned _____ _____, a corporation organized under the laws of the State of _____, a partnership consisting of _____ or individuals trading as _____ of the City of _____, 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 schedule.

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 - FABRICATED STEEL PIPE
Designated manufacturer _____
Designated supplier _____

ITEM 2 - BUTTERFLY VALVES
Designated manufacturer _____
Designated supplier _____

ITEM 3 - CHECK VALVES
Designated manufacturer _____
Designated supplier _____

ITEM 4 – AUTOMATIC SELF CLEANING FILTERS

Designated manufacturer Amiad Water Systems

ITEM 5 – BRIDGE CRANE

Designated manufacturer _____

Designated supplier _____

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 above bid or bids.

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, 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 project shall be completed April 1, 2023.

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.

BID SCHEDULE

RIVERTON CITY

13400 SOUTH CANAL FILTER BANK

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. L.F. is equal to linear-feet, S.F. is equal to square-feet and C.Y. is equal to cubic-yards.

BID SCHEDULE "A": PIPE AND FITTINGS

Item No.	Description	Estimated Quantity	Unit	Amount
1	Pipe and Fittings: complete with all demolition, site improvements, piping, fittings, electrical, and installation of (4) owner provided Amiad filters.	1	L.S.	
2	Vertical Adjustment of 20-inch Pipe	1	E.A.	
TOTAL BID SCHEDULE "A"				
TOTAL BID AMOUNT (IN WORD FORM):				

OPTION BID SCHEDULE "B": CRANE AND FRAMWORK
(City reserves the right to not award the Option Bid Schedule "B")

Item No.	Description	Estimated Quantity	Unit	Amount
1	Crane and Framework: complete with all additional structural components for the hoist system including, steel frame, grating, pier footings, crane components, and roofing.	1	L.S.	
TOTAL BID SCHEDULE "B"				
TOTAL BID AMOUNT (IN WORD FORM):				

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 90 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

(Corporate Seal)
If bid is by corporation

By_____

_____
Title

_____
Witness: if bidder is an individual

Bidder's post office address:

_____

_____

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

Bidder’s street address:

_____

_____

_____

_____

Bidder’s phone number:

SEAL

_____

MEASUREMENT AND PAYMENT

GENERAL

The method of measurement and payment for the various items comprising the completed work follows: Payment for the items shall be compensation in full for the furnishing of all overhead, labor, material, tools, equipment, and appurtenances necessary to complete the work in a good, neat, and satisfactory manner as indicated on the Plans or as specified, with all connections, testing, painting, cleanup, and related work completed. Each item, fixture, piece of equipment, etc., shall be complete with all necessary connections and appurtenances for the satisfactory use and/or operation of said item. No additional payment, including work done by the contractor for his convenience, shall be made for work related to each item unless specifically noted or specified. Measurement shall be in place in the completed work with no allowance for waste.

BID SCHEDULE "A"

ITEM 1: PIPE AND FITTINGS

This item shall be compensation in full for the complete furnishing and installation of the secondary water pipe and fittings. This item shall include, but is not limited to: demolition, site work, site piping, connections to existing piping, concrete, fabricated piping, valves, fittings, electrical work, painting, fencing, testing, installation of owner provided filters, submittals, coordination, project management, overhead, as-builts, O&M manuals, and all appurtenances and work necessary for a functioning and usable facility

ITEM 2: VERTICAL ADJUSTMENT OF 20-INCH PIPE

Measurement for payment for the vertical adjustment of the existing pipe shall be by the number of adjustments made. Payment shall be made at the unit price bid per sides adjusted. Such payment shall be compensation in full This item shall be compensation in full for the complete furnishing and installation of the fitting necessary to adjust the elevation of the existing buried pipe. This item shall include, but is not limited to excavation, sleeve, bedding material, compaction, backfill, concrete, submittals, coordination, project management, overhead, as-builts, O&M manuals, and all appurtenances and work necessary for a functioning and usable facility

BID SCHEDULE "B"

ITEM 1: CRANE AND FRAMEWORK

This item shall be compensation in full for the complete furnishing and installation of the hoisting system. This item shall include, but is not limited to: steel framework, pier footings, grating, roofing, crane components, painting, submittals, coordination, project management, overhead, as-builts, O&M manuals, and all appurtenances and work necessary for a functioning and usable system.

* * * END OF MEASUREMENT AND PAYMENT * * *

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 _____ as Principal, and _____ as Surety, are held and firmly bound unto Riverton City, hereinafter called "Owner", in the sum of _____ dollars,
(not less than 5 percent of the total amount of the bid)
for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, said Principal has submitted a bid to said Owner to perform all work required under the bidding schedule(s) _____ of the Owner's Specifications entitled 13400 SOUTH CANAL FILTER BANK

NOW THEREFORE, if said Principal is awarded a contract by said Owner and, within the time and in the manner required under the heading "Instructions to Bidders" bound with said Specifications, enters into a written contract on the form of Agreement bound with said Specifications and furnished the required bonds, one to guarantee faithful performance and the other to guarantee payment for labor and materials, then this obligation shall be null and void, otherwise it shall remain in full force and effect. In the event suit is brought upon this bond by said Owner and judgement is recovered, said Surety shall pay all costs incurred by said Owner in such suit, including a reasonable attorney's fee to be fixed by the court.

SIGNED AND SEALED, this ____ day of _____, 20___.

_____ (SEAL) _____ (SEAL)
(Principal) (Surety)

By: _____ By: _____
(Signature) (Signature)

(SEAL AND NOTARIAL ACKNOWLEDGMENT OF SURETY)

INFORMATION REQUIRED OF BIDDER

RIVERTON CITY

13400 SOUTH CANAL FILTER BANK

GENERAL INFORMATION

The bidder shall furnish the following information. Failure to comply with this requirement will render the Proposal informal and will cause its rejection. Additional sheets shall be attached as required.

(1) Contractor's name and address:

_____

_____

_____

(2) Contractor's telephone number: _____

(3) Contractor's license: Primary classification: _____

State License No.: _____

(4) Number of years as a contractor in construction work of this type:

_____

(5) Names and titles of all officers of contractor's firm:

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

(6) Name of person who inspected site of proposed work for your firm:

Name: _____ Date of Inspection: _____

NOTE: THE FOLLOWING INFORMATION SHALL BE PROVIDED AS SEPARATE ATTACHMENTS AND SHALL BE SUBMITTED WITH BID:

(7) Individual experience resume of person who will be designated chief construction superintendent.

(8) The bidder must demonstrate the ability to perform at least seventy five percent of the work without subcontracting. Information on the bidder's ability to staff the project, both in the field and in his office, and the bidder's ability to directly supply major construction equipment to the project shall be submitted for review with the bidder's proposal.

(9) Experience showing the Firm and Project Superintendent have completed 3 projects of similar type, complexity, and comparable value within the last 3 years.

AGREEMENT

THIS AGREEMENT, made and entered into this___ day of_____, 20__, by and Between Riverton 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 13400 SOUTH CANAL FILTER BANK 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 judgement period.

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

OWNER

Riverton City

Attest: _____ By: _____
Signature Signature

_____ _____
Title Title

(Seal)

CONTRACTOR

Attest: _____ By: _____
Signature Signature

_____ _____
Title Title

LABOR AND MATERIAL BOND

KNOW ALL MEN BY THESE PRESENTS,

That _____ as Contractor, and _____ as Surety, are held firmly bound unto Riverton City hereinafter called "Owner", in the sum of _____ _____ dollars,

for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, said Contractor has been awarded and is about to enter into the annexed contract with said Owner to perform all work required under the bidding schedule(s) ____ of the Owner's Specifications entitled 13400 SOUTH CANAL FILTER BANK

NOW THEREFORE, if said Contractor, or subcontractor, fails to pay for any materials, equipment, or other supplies, or for rental of same, used in connection with the performance of work contracted to be done, or for amounts due under applicable State law for any work or labor thereon, said Surety will pay for the same in an amount not exceeding the sum specified above, and, in the event suit is brought upon this bond, a reasonable attorney's fee to be fixed by the court. This bond shall inure to the benefit of any persons, companies, or corporations entitled to file claims under applicable State law.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Title 14, Chapter 1, Utah Code Annotated 1953, as amended, and all liabilities on this bond shall be determined in accordance with said provisions to the extent as if it was copies at length herein.

PROVIDED, that any alterations in the work to be done or the materials to be furnished, or changes in the time of completion, which may be made pursuant to the terms of said contract, shall not in any way release said Contractor or said Surety thereunder, nor shall any extensions of time granted under the provisions of said contract release either said Contractor or said Surety, and notice of such alterations or extensions of the contract is hereby waived by said Surety.

SIGNED AND SEALED, this ____ day of _____, 20__.

(SEAL)	_____ (SEAL)
(Contractor)	(Surety)
By: _____	By: _____
(Signature)	(Signature)

(SEAL AND NOTARIAL ACKNOWLEDGMENT OF SURETY)

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS,

That _____ as Contractor, and _____

as Surety, are held firmly bound unto Riverton City hereinafter called "Owner", in the sum of _____ dollars, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, said Contractor has been awarded and is about to enter into the annexed contract with said Owner to perform all work required under the bidding schedule(s) _____ of the Owner's Specifications entitled 13400 SOUTH CANAL FILTER BANK

NOW THEREFORE, if said Contractor shall perform all the requirements of said contract required to be performed on his part, at the times and in the manner specified therein, then this obligation shall be null and void, otherwise it shall remain in force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Title 14, Chapter 1, Utah Code Annotated 1953, as amended, and all liabilities on this bond shall be determined in accordance with said provisions to the extent as if it was copies at length herein.

PROVIDED, that any alterations in the work to be done or the materials to be furnished, or changes in the time of completion, which may be made pursuant to the terms of said contract, shall not in any way release said Contractor or said Surety thereunder, nor shall any extensions of time granted under the provisions of said contract release either said Contractor or said Surety, and notice of such alterations or extensions of the contract is hereby waived by said Surety.

SIGNED AND SEALED, this _____ day of _____, 20_____.

(SEAL)	_____ (SEAL)
(Contractor)	(Surety)
By: _____	By: _____
(Signature)	(Signature)

(SEAL AND NOTARIAL ACKNOWLEDGMENT OF SURETY)

NOTICE OF AWARD

RIVERTON CITY

13400 SOUTH CANAL FILTER BANK

TO: _____

_____

_____

PROJECT DESCRIPTION: 13400 SOUTH CANAL FILTER BANK

Riverton 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

RIVERTON CITY

13400 SOUTH CANAL FILTER BANK

TO: _____ DATE: _____

_____

_____

PROJECT DESCRIPTION 13400 SOUTH CANAL FILTER BANK

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: 13400 SOUTH CANAL FILTER BANK
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		$_____

	Previous Period	This Period
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 - RIVERTON 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: 13400 SOUTH CANAL FILTER BANK

OWNER: RIVERTON 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

RIVERTON CITY

To All Whom it May Concern:

WHEREAS, the undersigned Contractor has furnished labor and materials under a contract dated for the project named 13400 SOUTH CANAL FILTER BANK of which RIVERTON 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

RIVERTON CITY

Project Name 13400 SOUTH CANAL FILTER BANK

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: _____

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.

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 termini of the project as may be necessary or desirable to insure 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 therefor 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 classed as extra work when determined by the Engineer that such work is not covered by the Contract.

5-5 CHANGE ORDER

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.

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 * * *

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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 * * *

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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 13400 South Canal Filter Bank.

010011 SUMMARY OF WORK

Construction of new Secondary Water canal crossing piping . Work includes replacement of two 20-inch secondary water pipe sections spanning the Utah and Salt Lake Canal at 13400 South. The project will include installation of (4) new owner provided Amiad filters, new pipe and fittings, a new 1-ton bridge crane and the associated steel frame, site work, and electrical. Other work pertinent to these improvements is shown on the Plans.

010012 LOCATION OF PROJECT

The 13400 South Canal Filter Bank project site is located on the north side of 13400 South at approximately 2300 West in Riverton City, 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 Riverton City before beginning construction including a building permit from the Building Department and a Land Disturbance & Encroachment Permits from the Engineering Department. The Owner will pay all fees associated with the permits. The Contractor shall comply with all provisions associated with the permit.

2. The Contractor shall have any portion of the projects 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 or state laws.

5. 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.

6. All roads shall be protected from mud and debris and kept clean and swept during the course of construction. The Contractor shall obtain a permit from the City for traffic control measures in order to complete the work and shall abide by all provisions associated therewith.

7. The Owner has contacted Rocky Mountain Power and generated a work order for the new electrical service required at the Green Well Pump Station. The Contractor will be responsible for installation of conduits, transformer pad, metering cabinet, and disconnect. Connection to the power source, placement of wires, supply and installation of transformer, and setting of meter will be completed by

Rocky Mountain Power. Scheduling/coordinating the work with Rocky Mountain Power shall be the responsibility of the Contractor.

8. The Owner has contacted Questar Gas for new gas service at the Green Well Pump Station. The contractor shall coordinate installation of the new gas service to the Green Well Pump Station with Questar Gas.

10. The Contractor shall protect the artesian well from flowing and contamination during construction.

11. A temporary fence surrounding the work sites will be required for the protection of pedestrians on 12400 South and in the park. Detour/closure signs shall be provided to route pedestrians around the site. At the conclusion of the project a permanent perimeter fence shall be installed as shown on the Plans. Site security shall be maintained at all times.

12. A geotechnical investigation has indicated the presence of undocumented fill soils within the footprint of the pump station and site work. These undocumented fill soils shall be removed down to undisturbed native ground beneath all footings, pavement, and concrete flatwork. The same material that is removed may be used as non structural backfill except where noted on the plans including utility trenches for ferrous pipe, as this onsite soil has been determined to be highly corrosive. The Contractor shall have the excavation inspected by the Engineer prior to beginning backfill or placing forms for footings.

13. The Owner has applied for approval of a Water Rights Change Application and Stream Alteration Permit from the Division of Water Rights and a General Permit on Sovereign Land from the Division of Forestry, Fire & State Lands for work associated with the Jordan River. Bid Schedule "B" – Jordan River Filters will not be awarded until these approvals have been granted and the permits are in place which may delay issuance of award of this schedule. Contractor shall be given copies of these permits and agree to all conditions prior to the Owner's issuance of the award.

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 bench mark 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 RIVERTON CITY

All work performed under this contract shall conform to the permits issued by Riverton City.

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: Riverton City, 12830 South Redwood Road, Riverton City, UT 84065

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, that are active in the execution of the Work. The purpose of these meetings shall be to expedite the work of any subcontractor or other organization that is not up to schedule, resolve conflicts, and in general, coordinate and expedite the execution of the Work.

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

Item	Description of Item	Lump Sum Cost
1.	Mobilization	
	a. Specified bonds and insurance	_____
	b. Contractor's office at the site of the Work	_____
	c. Field office for Engineer	_____
	d. Permits, licenses, and fees directly related to and necessary for the performance of the Work	_____
	TOTAL FOR THIS ITEM	_____
2.	Sitework	
	a. General earthwork and grading	_____
	b. Dewatering	_____
	c. Shoring, bracing, and sheet pile	_____
	d. Imported fill	_____
	e. Fencing	_____
	f. Concrete Sidewalk	_____
	g. Concrete Curb & Gutter	_____
	h. Asphalt	_____
	TOTAL FOR THIS ITEM	_____
3.	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. Bridge Crane & Steet Frame

a.	Division 2 items (list out separately)	_____
b.	Division 3 items (list out separately)	_____
c.	Division 9 items (list out separately)	_____
d.	Division 10 items (list out separately)	_____
e.	Division 11 items (list out separately)	_____
f.	Division 12 items (list out separately)	_____
g.	Division 13 items (list out separately)	_____
h.	Division 14 items (list out separately)	_____
i.	Division 15 items (list out separately)	_____
j.	Division 16 items (list out separately)	_____

TOTAL FOR THIS ITEM _____

5. General Electrical (not included above)

TOTAL FOR THIS ITEM _____

6. 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	Paints, Coatings and Sealants
Backfill Materials	Pipe, Fittings, and Specials
Caulking	Pipe Supports and Anchors
Check Valves	Plumbing Fixtures
Concrete Mixes	Pressure Gauges
Control Valves	Pumps
Crushed Rock	Tanks
Drains	Pumps and Controls
Electrical Fixtures and Appliances	Rebar & Rebar Shop Drawings
Electrical Load Centers, MCC	Sealants
Electrical Substations, Transformers and	Signs
Electric Conduit, Wire and Specials	Sleeves
Engineered Fill	Strainer
Fabricated Metals	Structural Steel
First Aid Kit	Sky Lights
Screen	Switch Gear
Grating	UBC
Hardware	Valves
Imported Fill	Valve Operators and Controllers
Instrumentation	Ventilation Equipment
Meters and Meter Panels	Waterstop
Motors, Starter, and Controls	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 (six copies) shall be submitted to the Engineer to allow him to retain four (4) copies of each submittal. 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. Steel Pipe
2. Butterfly valves
3. Check valves

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

There is no electrical service currently available at the project site. The Contractor shall be responsible for obtaining and paying for any temporary service or power generating facilities at the site.

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 may obtain a water meter from the City for use on a nearby fire hydrant. The Contractor shall provide the City a deposit for the meter which will be returned upon return of the meter in satisfactory condition. The Contractor will not be required to pay for construction water provided that he is not negligent in its use.

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 the 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 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.

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

SITEWORK

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 1,000 linear 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 200 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 design purposes and is located in the Appendix.

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.

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, whalers, 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:

Location	Percent
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 Type A	Gravel Fill Type B	(UBC) Aggregate Base
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
No. 200	0- 12	0- 12	3- 12

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.

Sieve Size (Square Opening)	2-inch Crushed Drain Rock Percent By Weight Passing Screen	3/4-inch Crushed Drain Rock Percent By Weight Passing Screen
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 shall be sand as described herein. Bedding shall be tamped or compacted to a minimum of 90 percent T-99 lab density.

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:

Roller	Roller Rating	Wheel Load	Tire Inflation Pressure

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 l0 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 insure 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 insure 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 insure 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.

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 BITUMINOUS PRIME COAT

The bituminous prime coat shall consist of an application of hot bituminous material on a previously prepared base course or other surface to be paved. Prior to the application of the prime coat, an inspection of the area to be coated will be made by the Engineer to determine its fitness to receive the bituminous priming material. If aggregate base course to be primed contains an appreciable amount of loose material or is excessively dusty; moisten, blade, roll, and recompact to make the surface dense. Do not start priming until all free surface moisture has disappeared. Notify all residents and business owners 24 hours prior to applying prime coat. Provide pedestrian access across prime coat if required.

Bituminous material used for the prime coat shall conform to the requirements for MC-70. MC-70 shall be applied at a temperature of 175 degrees F to 225 degrees F. When Pavement surface under Pavement overlay is loosely bonded, apply prime coat at 0.10 to 0.50 gallons per square yard to penetrate and seal. Do not flood surface. Cure and dry as long as necessary to attain penetration and evaporation of volatile. Blot over-primed surface by spreading a light, uniform layer of sand. Prime under-primed areas with additional bituminous material.

Protect all structures, including curb and gutter, sidewalks, guardrails and guide posts from being spattered or marred. Remove any spattering, over-coating, or marring at not additional cost to OWNER. Do not discharge bituminous material into borrow pits or gutters. Prevent tracking of prime coat onto adjacent surfaces.

Do not permit traffic to travel over freshly primed surface until prime coat has cured. If detours cannot be provided, restrict operations to a width suitable at least for one-way traffic over the remaining portion of the road. If traffic is limited to one-way travel the contractor shall provide adequate traffic control at no additional cost to the owner.

After prime coat application, leave work area undisturbed. If prime coat is tacky or tends to pick up under traffic after 4 hours, blot excess prime coat with blotter sand. Prime coats can be opened to traffic after blotting.

Clean and maintain primed surfaces until surface Pavement course is placed. Maintenance includes spreading any necessary additional blotter material, replacing all portions of prime coat that have been destroyed, and patching any break in primed surfaces.

Apply prime coat only when air and roadbed temperatures in the shade are greater than 40 degrees F. The temperature restrictions may be waived only upon written authorization from ENGINEER. Do not apply prime coat during rain, fog, dust, or other unsuitable weather.

020623 TACK COAT

Asphalt which is existing and is to be paved over shall be tack coated with a Grade CSS-1h anionic emulsion. Clean the surface to be treated free of dust and other foreign material. If flushed, allow surface to dry and if leaves from trees cover surface, blow to clean surface. Provide surface for pedestrian access across tack coat. Prevent pedestrians, vehicles, pets, etc., access to tack surfaces.

Tack coat shall be applied with triple coverage by spray bar. Application shall be stopped if any nozzle is not working properly. Apply tack only to area covered with asphalt concrete in the same day. Emulsified asphalt shall be applied at a rate of 0.05 to 0.15 gallons per square yard. Where paving fabric is applied over the tack coat, the application rate shall be increased to include the Asphalt retention value of the paving fabric.

Protect all surfaces exposed to public view from being spattered or marred. Remove any spattering, over-coating, or marring. Do not discharge bituminous material into borrow pits or gutters.

Do not permit traffic to travel over the tacked surface until bituminous tack coat has cured or is not picked up by traffic. If detours cannot be provided, restrict operations to a width suitable at least for one-way traffic over the remaining portion of the road. If one-way traffic is provided, control traffic appropriately.

020625 GEOTEXTILE REINFORCEMENT FABRIC

A geotextile fabric shall be provided at the locations indicated on the Plans. The geotextile shall be ProPex 4550 as manufactured by Amoco Fabrics with the following properties, or equal:

Property	Min. Avg. Roll Value
Grab Tensile	135 lb
Grab Elongation	50%
Mullen Burst	270 psi
Puncture	80 lb
Trapezoidal Tear	56 lb
UV Resistance	70% at 500 hrs
AOS	70 sieve
Permissivity	1.7 sec^{-1}
Flow Rate	120 $gal/min/ft^2$

020630 ASPHALT CONCRETE

Asphalt pavement replacement shall be in accordance with Riverton City standards (AC-20-DM-1/2 per APWA 33 05 25 Pavement Restoration). Asphalt cement shall conform to the requirements for asphalt cement, AASHTO M-226. Mixing temperature shall be not lower than 275 degrees F, nor higher than 325 degrees F.

020640 MIXING

Before being delivered to the site, the aggregate shall be mixed with the asphalt cement at a central mixing plant. Mixing plants shall be in good working order with no excessively worn parts and so equipped as to assure that:

A. Temperatures of aggregates leaving the dryer, of asphalt cement entering the mixer, and of mix leaving the mixer can be readily determined and positively controlled within specification limits at all times.
B. The asphalt cement can be uniformly distributed throughout the mixture with the aggregate completely coated.
C. The mixing time can be positively controlled to the minimum specified.
D. Bin samples of aggregate can be readily obtained.

The Contractor shall provide means of calibrating weighing devices.

020641 MIXING PLANT

The plant shall be equipped with a dryer suitably designed to heat and dry the aggregate to specification requirements and to agitate it continuously during the heating. The dryer shall be capable of preparing aggregates at a rate equal to the full rated capacity of the plant. The plant shall be equipped with a dust collector so constructed as to waste or return uniformly to the hot elevator all or any part of the material collected. The mixer shall be of adequate capacity and Accurate thermometers shall be furnished, suitable for determining the temperature of the mix.

All weighing equipment shall be tested and sealed by a representative of the Inspector of Weights and Measures having jurisdiction, as often as the Engineer may deem necessary to insure accuracy.

Tanks for storage of bituminous material shall be capable of heating the material under effective and positive control at all times to temperatures within the range stipulated.

020642 PLANT OPERATION

When a continuous mixer is used, determination of the mixing time shall be by weight method using the following formula:

$$\text{Mixing time in seconds} = \frac{\text{Pugmill dead capacity in pounds}}{\text{Pugmill output in pounds per second}}$$

020650 DELIVERY AND PLACING

Placing and compacting of the asphalt mixture shall progress in sections generally not more than 750 linear feet in length. The mixture shall be spread, shaped, and finished by equipment as specified. The mixture shall be placed in uniform strips for the full width to be paved. Each successive strip shall be spread adjacent to the previously spread strip. A 6-inch width of each strip adjacent to which a new strip is to be placed shall not be rolled until after the new strip has been placed.

020651 DELIVERY

The mixture shall be transported from the mixing plant to the point of use in pneumatic-tired vehicles having tight bodies previously cleaned of all foreign materials. Bodies shall be treated as necessary to prevent material from sticking. Each load shall be covered with canvas or other suitable material of sufficient size and thickness to protect the asphalt mixture from the weather. The mixture shall be placed on the roads, pavements, or walks at a temperature not less than 225 degrees F.

020652 PLACING EQUIPMENT

Equipment for placing, spreading, shaping, and finishing asphalt concrete shall consist of a self-contained power machine operating in such manner that no supplemental spreading, shaping, or finishing will be required to provide a surface which will comply with the requirements for smoothness contained herein. In areas inaccessible to the machine, hand spreading may be permitted. The Contractor shall furnish at least one self-propelled, pneumatic-tire roller, and one 10-ton (minimum), smooth-wheel tandem roller.

020653 PLACING AND COMPACTING

The surface of the aggregate base course shall be cleaned and then shall receive a prime coat as previously specified, before placing asphalt concrete.

Any existing base, surfacing, or pavement shall be thoroughly cleaned immediately prior to receiving the plant-mixed surfacing. Where existing pavement is being widened or extended, it shall be cut to a straight vertical face prior to the paving operations and treated with asphalt paint binder.

When asphalt concrete is to be applied over existing pavement and local irregularities in the existing surface would result in a course of more than specified thickness, the surface of the existing pavement shall be brought to uniform contour by applying a leveling course with asphalt concrete thoroughly tamped or rolled until it conforms with the surrounding surface, and a tack coat applied.

Spreading shall be as nearly continuous as possible. When asphalt concrete is laid against vertical surfaces such as gutters, the face of the vertical surface shall be roughened for proper bonding, cleaned, and then painted with a light coating of asphalt cement or emulsified asphalt.

At terminations of new surface course, the asphalt concrete shall be feathered into the existing surface over such a distance as may be required to produce a smooth riding transition. Base course and single course construction shall be joined by vertical butt joints finished and rolled to a smooth surface.

Initial or "breakdown" rolling shall be performed with a tandem power roller and shall follow the spreading operation when the mixture has reached a temperature where it does not "pick up" on the rolls. Rolls shall be kept properly moistened but a surplus of water will not be permitted. Rolling with pneumatic roller shall follow initial rolling when the mixture is in proper condition and when the rolling does not cause undue displacement, cracking, or shoving. Rolling shall begin at the sides and progress gradually to the center, lapping each preceding track until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 3 feet distant from any preceding stop.

At any place not accessible to the roller, the mixture shall be thoroughly compacted with tampers and finished, if necessary, with a hot iron to provide a uniform layer over the entire width being paved.

The finished surface shall be of uniform texture. When tested with a 10-foot straightedge laid on the surface parallel with the centerline of the road, the variation of the surface from the testing edge of the straightedge shall not be more than 1/4-inch.

The specific gravity of the compacted mixture shall not be less than 95 percent of the specific gravity of specimens composed of the same materials in similar proportions or composed of the same mixture, compacted in the laboratory by the 75-blow method of ASTM D 1559.

020654 FOG SEALING

Where called out in the plans, asphalt pavement shall be fog sealed with an asphalt emulsion after compaction. The asphalt emulsion shall be Grade SS-1h and applied at the rate of 0.05 gallons per square yard.

020660 FULL-DEPTH ASPHALT PAVEMENT

The Contractor, at his option, shall install either asphalt and aggregate base material or full-depth asphalt pavement in all areas where paving is indicated or specified to be 2 inches of asphalt concrete over aggregate base course. If the Contractor elects to install full-depth asphalt pavement, the subgrade shall be prepared as previously described. Asphalt concrete shall be substituted for aggregate base at a ratio of 1 inch of asphalt concrete to 2-1/2 inches of aggregate base material except that full-depth asphalt pavement shall be not less than 4 inches in thickness after compaction. Asphalt concrete shall be placed in courses of not more than 4 inches.

Compaction equipment used shall be in accordance with the following course thicknesses:

1-inch to 2-inch thickness, minimum 8-ton roller
2-inch to 3-inch thickness, minimum 10-ton roller
3-inch to 4-inch thickness, minimum 12-ton roller

Pneumatic rollers used for initial or secondary rolling shall be 12 to 15 tons with tires capable of applying 90 psi.

Asphalt concrete for full-depth pavement shall be asphalt concrete as previously specified in this Section. Bituminous prime coats shall be applied where full-depth asphalt pavement is installed. If the Contractor elects to use full-depth asphalt pavement, the UBC road shoulders shall be reduced to a minimum aggregate thickness of 4 inches.

Except for asphalt thickness, aggregate base course thickness and prime coating, full-depth asphalt pavement shall comply with all requirements of these Specifications.

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.

*** 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, watertightness, 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 1/2 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 Concressive 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 insure 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 WITH AIR ENTRAINMENT

Class	Compressive Strength At 28-Day (psi)	Max. Net* Water to Cement Ratio by Weight	Min. Cement* Per Yard of Concrete (pounds)	Consistency Range In Slump (inches)
A	4,000	0.45	564	3 to 5**
B (Type III cement)	4,000	0.48	564	2 to 4**
C	2,500	0.62	423	3 to 6
D	4,500	0.45	658	2 to 4
CE	2,500	0.62	564	3 to 6

* See 030180.
** NOTE: Slump for slabs, decks, walks, and beams shall be not more than 3.5 inches.

TABLE B

CLASS “A” MIX DESIGN

CEMENT	594 LB/CY
AIR	6%
WATER	32 GAL/CY
CRUSHED ROCK	3/4"-#4 / 60 - 65%
SAND	35 - 40%
SLUMP**	3" Min. to 5" Max.
28 DAY STRENGTH	4000 PSI, MINIMUM
WATER/CEMENT RATIO	0.45
SUPERPLASTICIZER*	
WATER REDUCING AGENT*	

POZZOLAN OR FLY ASH MAY NOT BE USED
CEMENT TO BE TYPE II (ASTM C 150)
SUPERPLASTICIZER (ASTM C-494 TYPE A/F)

* Dosages shall not exceed manufacturer's recommended amounts.
** Slump for walls shall not be less than 5.0 inches.

CLASS "C" MIX DESIGN

CEMENT	4.5 SACKS/CY
AIR	4%
WATER	0.62 Water Cement Ratio
CRUSHED ROCK	3/4"-#4 / 60 - 65%
SAND	35 - 40%
SLUMP**	3" Min. to 6" Max.
28 DAY STRENGTH	2,500 PSI, MINIMUM
WATER/CEMENT RATIO	0.45
SUPERPLASTICIZER*	
WATER REDUCING AGENT*	

POZZOLAN OR FLY ASH MAY NOT BE USED
CEMENT TO BE TYPE II (ASTM C 150)

* Dosages shall not exceed manufacturer's recommended amounts.
** Slump for walls shall not be less than 5.0 inches.

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.

	Test Method	Percent
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.

	Test Method	Percent
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

All concrete 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.

Item	Maximum Tolerance, inches
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

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, Elasto-thane 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 Concressive 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; Concressive 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:

	Slab Bars, inches	Wall Bars, inches
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 Concressive 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 swirl broom finish. Stiff bristle brooms or brushes shall not be used. 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:

Interior & exterior exposed walls	Finish - F4
Interior floor slabs	Finish - S5

The following surfaces shall be troweled, then given a light hairbroom 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
Floor slabs
All other surfaces not specified to be finished otherwise

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.

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 Concressive 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 NONSHRINK GROUT

Nonshrink grout shall be made with a hydraulic cement, which when mixed with water will harden rapidly to produce a permanent high strength material suitable for exterior use. Nonshrink 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. Nonshrink grout shall be Five Star Grout manufactured by U.S. Grout Corporation, Masterflow 7l3 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; Concressive 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; Concressive 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 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:

Item	ASTM Standard No.	Class, Grade, Type or Alloy No.
Cast Iron		
Cast Iron	A 48	Class 40B
Steel		
Galvanized sheet iron or steel	A 446 A 525 A 526	Coating G90
Black steel, sheet or strip	A 569 A 570	
Coil (plate)	A 635	
Structural plate, bars, rolled shapes, and misc. items	A 36	
Standard bolts, nuts, and washers	A 307 A 325	
High strength bolts, nuts, and hardened flat washers	A 325 A 490	
Eyebolts	A 489	Type 1
Tubing, cold-formed	A 500	
Tubing, hot-formed	A 501	
Steel pipe	A 53	Grade B
Stainless steel		
Plate, sheet and strip	A 167	Type 304 or 316
Bars and shapes	A 276	Type 304 or 316
Aluminum		
Sheet aluminum-flashing	B 209	Alloy 5005-H14, 0.032 inches min. thickness
Sheet aluminum-structural	B 209	Alloy 6061-T6

Structural aluminum	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:

Diameter Inches	Embedment Length Inches
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

Preformed 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.

055340 STEEL GRATINGS

Steel gratings shall be hot-dip galvanized in accordance with ASTM A 123. Steel grating shall be supported on shelf angles. Steel 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 18,000 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.

Steel grating shall be IKG Weldforged steel grating manufactured by IKG Borden Industries, Nashville, Tennessee; Type 19W4 manufactured by Seidelhuber Metal Products, Inc., San Carlos, California; or equal.

056000 MISCELLANEOUS METAL

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.

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, facia, 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 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

Brand Name	Manufacturer
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 repreparing 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

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.

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

Pipe Contents	Background Color	Band
Hydrofluorosilic Acid	Light Blue	Red
Natural Gas	Red	None
Sodium Hypochlorite	Yellow	None
Water, Potable	Blue	White

COLOR CHART

Color	Sherwin-Williams	Glidden	Koppers
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 requirement. (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.

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.

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.

B. 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.

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 and piping.

d. Equipment supports

C. Colors.

1. See 090100, 090146, 090146.01, and 090184.

D. Pipe Marking.

1. See 090146.01.

E. Dissimilar Metals

1. See 090149.

F. Safety Strips

1. See 100140 and 100150.

*** END OF DIVISION 9 ***

DIVISION 13-C

FILTERS

INSTALLATION OF OWNER PROVIDED EQUIPMENT

131000 GENERAL

This section covers the installation of owner provided equipment. The owner has ordered four Amiad EBS-1000 Filters. Copies of a purchase order and specifications for this equipment will be provided. This purchase order will be assigned to the Contractor upon delivery. The Contractor is therefore required to include the cost of labor and equipment necessary to install, test and demonstrate the equipment. This includes the coordination of the delivery with the supplier.

131020 RESPONSIBILITY FO THE CONTRACTOR

Upon assignment by the owner for the purchase order to the Contractor, the Contractor shall assume ownership of the purchase order. The contractor shall coordinate with the supplier, make all installations, provide field services, and perform start-up and testing. The Contractor shall maintain responsibility for a complete working system for all owner provided equipment, the same as if the Contractor had ordered the equipment following the award of the contract.

131030 INSURANCE

The Contractor shall include in his insurance coverage for the work under this contract, sufficient coverage to protect the owner provided equipment and materials against all losses during unloading, storage, and until final acceptance of the work by the owner. The owner shall be named as co-insured for this equipment.

131100 PRODUCTS

131110 EQUIPMENT ITEMS ORDERED BY OWNER

The following equipment items have been selected and ordered by the owner:

1. (4) Amiad EBS-1000 Filters with 10” flanged suction and discharge connections

131120 CONTRACTOR-SUPPLIED EQUIPMENT AND MATERIALS

Except for equipment specifically specified as “owner provided”, all other materials required to complete the work under this section shall be provided by the Contractor. Such materials to be provided by the Contractor include, but are not limited to: connection piping and valves, lifting crane, piping accessories, bolts, expendable materials, and any other necessary materials to provide a compete and properly functions system.

131130 STORAGE AND PROTECTION

Following delivery of the owner provided equipment, and until final acceptance of the completed work, the contractor shall protect and maintain the equipment in a condition that will prevent damage in accordance with the engineer approved manufacturer's instructions. The Contractor shall replace equipment items that become damaged prior to final acceptance of the work.

*** END OF DIVISION 3 ***

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 4340 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 sublabeled. 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 trouble shooting 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 460-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.

		Full Load Rating, Percent				Full Load Rating, Percent	
Hp	rpm	Eff.	PF	Hp	rpm	Eff.	PF
1	1,800	84.0	79	30	3,600	91.0	91
	1,200	78.5	75		1,800	93.0	86
					1,200	92.4	85
1-1/2	3,600	81.5	91	40	3,600	91.7	90
	1,800	84.0	79		1,800	93.0	87
	1,200	82.5	75		1,200	93.0	85
2	3,600	84.0	89	50	3,600	91.7	91
	1,800	84.0	79		1,800	94.1	87
	1,200	84.0	68		1,200	93.0	86

3	3,600	82.5	89	60	3,600	92.4	90
	1,800	88.5	85		1,800	94.1	87
	1,200	86.5	74		1,200	93.6	86
5	3,600	86.5	86	75	3,600	93.0	92
	1,800	88.5	86		1,800	94.1	87
	1,200	87.5	85		1,200	94.1	86
7-1/2	3,600	86.5	88	100	3,600	93.6	90
	1,800	90.2	85		1,800	94.5	90
	1,200	88.5	85		1,200	94.1	86
10	3,600	87.5	90	125	3,600	93.6	90
	1,800	90.2	86		1,800	95.0	90
	1,200	86.5	85		1,200	94.5	90
15	3,600	89.5	88	150	3,600	94.1	90
	1,800	91.7	85		1,800	95.0	90
	1,299	90.2	85		1,200	94.5	90
20	3,600	90.2	90	200	3,600	94.1	93
	1,800	91.7	86		1,800	95.0	90
	1,200	91.0	85		1,200	94.5	87
25	3,600	91.0	90	250	3,600	94.1	93
	1,800	93.0	87		1,800	94.5	87
	1,200	92.4	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 Cal-OSHA, 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 ***

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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. All equipment shall be provided to make a usable system for lifting and moving the hydro-electric generator and turbine.

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 the vertical turbine pumps and pump cans.

140214 STRUCTURAL

The support frame for the runways shall be as detailed in the plans. The crane structural system, including the runways, the runway connections to the frame, and the bridge girder, 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 bridge crane system shall be provided consisting of runways, end trucks, a bridge girder, a manual push trolley, and a manual chain hoist. The bridge girder shall be supplied by crane system supplier to fit the application and loading.

The runway tracks shall be enclosed, cold formed, steel box track permits end trucks and festoon carriers to ride beneath the frame. The runway tracks shall be fabricated with a flat surface for higher durability and wheel contact. Splice joints shall include truss splice plates, channel-shaped track splice joints, bolts, lock washers, and nuts for joining runway sections. Splice joints must be located within four feet of a support point.

The end trucks shall be as follows:

1. Rigid frame designed to ride inside enclosed runway track and connect to and suspend bridge.
2. Stamped steel fabrication with both vertical and horizontal wheels to prevent binding in runway.

3. Wheels: Removable, self-centering wheels with sealed lifetime lubricated bearings. Vertical wheels shall be flat to match track profile. Non-removable or non-tapered wheels are not acceptable.
4. Drop Lugs: Included on both sides of truck to limit truck drop in the event of wheel or axle failure.
5. Connection to the bridge shall be a sliding or flexible connection.

The trolley system shall be as follows:

1. Two-piece stamped steel body with two wheels on each side and tapered clevis positioning hoist hook at center of trolley, so load weight is evenly distributed to all four trolley wheels. Includes removable clevis pin (type and size determined by manufacturer for specified capacity). Trolleys with non-removable clevis pins are not acceptable. Holes provided in body for mechanical connections.
2. The bridge girder shall be provided with integral stops that limit the travel of the trolley.
3. Maximum allowable deflection of the girder shall be the span divided by 600.
4. The hoist capacity of the crane shall be indicated on the bridge girder with 4" (minimum) high letters and numbers and shall be clearly visible from the operating floor.
5. Removable, self-centering wheels with sealed lifetime lubricated bearings. Vertical wheels shall be flat to match track profile. Non-removable or tapered wheels are not acceptable.
6. Drop lugs shall be included on both sides of trolley to limit trolley in the event of wheel, axle, or load bar failure.

140232 TROLLEY HOIST

A manual chain trolley hoist shall be provided. The hoist shall be an integrally built and supplied with an overload device.

The following hoists shall be provided:

Capacity (Tons)	Mounting Height Above Floor Ft.	Location/Use
1	12.5	Canal Crossing/Filter Maintenance

The hoist shall meet or exceed ANSI/ASME HST-2M standards and be designed to ANSI/ASME B30.16. the hoist system shall be as follows:

1. Load Chain: grade 100, heat-treated manganese alloy steel.
2. Gears: enclosed, double reduction gearing.
3. Hooks: forged, heat-treated alloy steel hooks.
4. Overload Protection: slop clutch device.
5. Break: double pawl springs.

The hoist shall be as manufactured by Harrington 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 ***

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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, he shall submit to the Engineer, for approval, his 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.

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.

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 4 inches and over in size may be cement lined ductile iron pipe.

Legend	Use	Piping	Joints/Fittings	Test Pressure
SW	Secondary Water Piping	Schedule 40 Steel Pipe	250# Flanged or Mechanical Joint	200 psi
D	Drain Piping	PVC SDR-35 or HDPE DR-17	Rubber Gasket/Bell & Spigot/Fusion Weld	4 psi (Air Test)

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 insure 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. 3BA6l5Al4Bl3 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.

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. Pipe 6 inches and smaller shall be Schedule 40. Pipe over 6 inches but not larger than 12 inches shall be no lighter than Schedule 20.

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 ½ inch, stub ends not less than 6 inches long and ½ 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. Mll. 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.

150232 EPOXY LINING

Aboveground steel pipe shall be painted as directed in DIVISION 9 of these Specifications. The coating system shall be applied in strict accordance with the manufacturer's instructions.

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.

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.

Pipe coating 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.

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

Nominal Pipe Size (Inches)	Outside Pipe Diameter (Inches)	Minimum Pipe Wall Thickness (Inches)
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

Nominal Pipe Size (Inches)	Outside Pipe Diameter (Inches)	Minimum Pipe Wall Thickness (Inches)
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.

Pipe Diameter Inches	Allowable Leakage Gallons/100 Joints/Hour
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

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)

	NOMINAL PIPE SIZE				
Length	12"	15"	18"	21"	24"
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 and 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, Con tractor 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.

a. The proof rings shall be available at the site of the Work during performance of mandrel tests.
b. The mandrel diameter shall not vary more than plus or minus one percent of the specified diameter.

152135 PIPE SADDLES

Pipe saddles shall be furnished and installed where indicated on the Plans. Pipe saddles shall be Series 336 or Series 338 as manufactured by R. H. Baker and Company, Inc.; Style 304 as manufactured by Ford Meter Box Company, 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 ½-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.

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.

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 cavitational 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 6-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 Lineseal 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.

153400.10 PLASTIC BODY 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 200 psi or better service and suitable for operation in either horizontal or vertical position. All PVC check valves shall be true union unless approved otherwise.

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 160 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:

10-inch check valve: 0.7-ft head loss @ 2000 gallons per minute

The valves shall be APCO series 800-B, Valmatic Tilted Disc, or approved 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.

153842 AIR RELEASE VALVE

Air release 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 discharge orifice area shall be equal or greater than the inlet of the valve. The valve shall consist of a body, cover, float and seat. 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/Dezurik Models as follows or approved equal.

Location	Valve
Header No. 2 West	2-inch, ARV Model No. 200A
Header No. 2 East	2-inch, ARV Model No. 200A

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 A48 Class 30
Float	Stainless Steel	ASTM A240
Seat	Buna-N	

*** END OF DIVISION 15 ***

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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 4600 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 and transformer pads.

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. New electrical service. The Contractor shall also be responsible for coordinating his work with the utility company regarding new electrical service work. The Contractor shall ensure that the utility company provide timely completion of the electrical service. The initial service request was made by the Owner, however, the Contract shall be responsible for coordination with the Utility Company. The Contractor shall contact the utility for complete work requirements prior to submitting bids. No additional charge to the Owner shall be allowed regarding the service. The Contractor will be responsible for the trench excavation, backfill, and transformer pad. Power supply wires will be installed in the open trench and conduits by the Power company. Transformer will be supplied and installed by the Utility Company.

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.

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.

160108.10 SHORT CIRCUIT FAULT ANALYSIS

The data and curves for a short circuit analysis and coordination study shall be performed by the Contractor and submitted. The study shall include all protective devices from the utility service to and including the 600 V distribution system, feeder to generators, feeders to motors, motor control centers, loads 50kVA and larger, and devices rated at 100 ampere and larger.

Each protective device indicated on the Drawings or specified herein shall have recommended settings submitted. The protective relays, fuses, and circuit breakers recommended selection of settings implementation shall be by a qualified Testing Service selected by the Contractor, and acceptable ot the Engineer.

The owner shall withhold payment for the electrical equipment until the studies are accepted and the results as implemented.

160108.20 SHORT CIRCUIT FAULT ANALYSIS

A short circuit fault analysis shall be performed by the Contractor to calculate a three phase bolted fault, line-to-line fault, line-to-ground fault, and double line-to-ground fault. This analysis shall be performed, stamped, and signed by a registered Electrical Engineer in the state where the project is located. The fault analysis shall include all new and existing distribution equipment.

The calculations shall indicate the RMS current values, both asymmetrical and symmetrical, at ½ cycle, for each bus and each short circuit protective device being supplied from the service equipment to the lowest rated overcurrent device or equipment. Existing buses, short circuit protective devices, and similar equipment which may be affected shall also be included in the calculations.

The electric utility available fault current shall be obtained by the Contractor and included in the study. Motor contributions, generator contributions, and other source contributions affecting the available fault current shall be included in the study.

The equipment interrupting and withstand ratings of the equipment the Contractor intends to supply, as part of this project as well as that for existing equipment affected, shall be indicated next to the resulting available fault current determined by the study.

The results of the short circuit fault analysis study shall be submitted for review and acceptance by the Engineer prior to the submittal of data for any major equipment intended to be supplied.

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:

Application	Conductors	Color
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 condulet type. Condulet 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 condulets 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 Tapped 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
Conduits in Chemical room	PVC Sch 80

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 lamicoid 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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161220.11 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) Benshaw, 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 Ramp Time	0 to 100% 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 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 continous 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 incorporates 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

Fixtures Type "A" (120 Volt AC)

The fixtures shall be 4 32 watt fluorescent pendant mounted type with all required hardware. The fixtures shall be industrial type with 15 percent uplight. The fixtures reflector shall be white porcelain. The fixtures shall be KEENE lighting products Model No. SNTP440RS, DAYBRITE equivalent, or equal. Fluorescent tubes shall be “Super White T-8" or equivalent trade name.

Fixtures Type "B" (120 Volt AC)

The fixtures shall be 70 watt high pressure sodium suitable for outdoor, wall mounted. The fixtures shall be die cast aluminum construction with integral HID ballast. The fixture reflector shall be heat and shock resistant borosiltcate glass and wireguard. The fixtures shall be KEENE Lighting Products Model No. 3237OLX-FS-330, Holophane equivalent or equal.

Fixtures Type "C" (120 Volt AC)

The fixtures shall be 4 32 watt fluorescent, pendant mounted, vapor tight, type with all required hardware. The fixtures shall be industrial type, one piece seamless welded construction, totally enclosed with 3/16 inch tempered glass lens and heavy duty gasket (neoprene). The door frame shall be hinged on one side and secured on both sides with plated spring steel toggle clamps.. The fixtures shall be KEENE lighting products Model No. 1 HPFW432, or equal.

Fluorescent tubes shall be “Super White T-8" or equivalent trade name.

Fixtures Type "L" (120 Volt AC)

The fixtures shall be 100 watt incandescent type, suitable for ceiling or wall mount. The fixtures shall be vapor tight with heavy duty glass glove and wire guard. The fixtures shall be light weight, corrosive resistant, copper free aluminum body. The fixtures shall be Crouse-Hinds Model No. EVBX, Appleton equivalent or equal.

Battery Pack Light

Unit shall be a dual head battery pack lighting. Lights to be Holophane No. EH-19-2H-120 V, Chloride NTNM 50-1k-2-120 V or equal.

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 ***

Invitation for Bid Instructions and General Provisions

"Failure to comply with the following instructions may cause rejection of this bid"

1. **Administrative Authority:**
   The administration of this purchasing process is conducted by the Riverton City Purchasing Agent. No contact of the City Mayor, City Council or any employee in regards to this solicitation other than those listed herein.
2. **No Obligation Implied:**
   This Invitation for Bid implies no obligation on the part of Riverton City.
3. **Contract requirements:**
   Any contract that may arise from this Invitation for Bid is subject to the following Terms and Conditions:
   INDEMNIFICATION - The contractor agrees to protect, indemnify and hold Riverton City, the City Council, the Mayor, and all employees (collectively the "Indemnities") free and harmless from and against all losses, claims liens, demands and causes of action of every kind and character arising out of performance of the Work by the contractor or by its subcontractors, including the amount of judgment, penalties, interest, court costs and legal fees incurred by the Indemnities or any of them in defense of the same, arising in favor of any party, including governmental agencies or bodies, on account of, but not limited to, taxes, claims, liens, debts, personal injuries, death or damages to property (including property of Indemnities). The Contractor further agrees to; investigate, handle, respond to, provide defense for and defend any such claim, demand or cause of action at its sole expense, and agrees to bear all other costs and expenses related thereto, even if such claim, demand or cause of action is due solely to the fault of Riverton City and, release, indemnify and hold the Buyer, its officers, agents and employees harmless from liability of any kind or nature, including the contractor's use of any copyrighted or uncopyrighted composition, secret process, patented or unpatented invention, article or appliance furnished or used in the performance of this contract. Riverton City is a governmental entity under the Governmental Immunity Act and waives no defenses, limits of liability or other rights.
   INDEPENDENT CONTRACT - It is understood and agreed by the parties that the contractor is to act in the capacity of an independent contractor and as such will have no authorization, express or implied to bind Riverton City to any agreements. Contractor's officers and employees shall not be considered as employees or officers of the City and shall not be entitled to any employee benefits as City employees as a result of the execution of this agreement.
   INSURANCE - The contractor agrees to acquire and maintain the appropriate insurance, in the appropriate amounts, for the service(s) provided. This may include, but not limited to workers compensation, liability and errors in omission. Proof of insurance will be provided to the City upon request.
   WORKFORCE - The Contractor agrees to register and participate in the Status Verification System to verify the work eligibility status of the Contractor's new employees that are employed in the state. The Contractor further agrees to have each contractor or subcontractor who works for or under main contractor, certify by affidavit that the contractor or subcontractor has verified through the Status Verification System the employment status of each new employee of the respective contractor or subcontractor.
4. **Riverton City Reservations:**
   The right is reserved to cancel this Invitation for Bid or to accept or reject any or all bids, and to waive any informality or technicality in any bid, in the interest of Riverton City. Riverton City reserves the right to award multiple contracts to more than one vendor for the same or similar items. Riverton City reserves the right for an option to renew or extend any contract that may arise from this Invitation for Bid, not to exceed four (4) renewals or extensions. Unless specifically provided for elsewhere in this bid, multiple or alternate bids will not be accepted. The City Mayor and City Council reserves the right to purchase such brands as they desires, irrespective of price. The right is reserved, unless supplier countermands, to increase or decrease the quantity of any item(s) as the bid price. Riverton City reserves the right to cancel any item(s) not delivered after the purchase order issued. Riverton City reserves the right to select some or all of the items from any vendor unless an "all or nothing" statement is included in the bid. Riverton City does not guarantee to make any purchase from this bid. Estimated quantities are for bidding purposes only and are not to be interpreted as a guarantee to purchase any amount.
5. **Failure to Respond:**
   Failure to respond may result in the removal of your firm from the vendor's list for the commodity(s) listed. Unless you advise the Purchasing Agent prior to the bid due date that you desire to receive future invitations to bid on this commodity. Three consecutive no responses will result in removal
6. **Bid Preparation:**
   A. Fill out this bid form completely filling in all blanks, either in ink or typewritten. All information provided must be legible.
   B. Errors may be crossed out and corrections made in ink or typewritten (no type covers) adjacent and must be initialed in ink by the person signing the bid.
   C. Any manufacturer's name, trade names, brand names or catalog number(s) used in this specification are there for the purpose of establishing and describing general performance and quality levels. Such references are not intended to be restrictive, and bids are invited on these and comparable brands or products by any manufacturer. All items will be evaluated on an ***"acceptable substitute"*** basis unless stated otherwise, Riverton City determining acceptability.
   D. Price each item separately and extend, unless each item makes up a complete system or a lot price requested. Unit price will govern if there is an error in the extension.
   E. Furnish descriptive literature for each item bid. If a substitute is offered make a full written explanation on the bid as to its brand name, model number etc.
   F. Submit your bid on the documents furnished herein.
   G. Do not bid on items you cannot supply promptly.
   H. Provide information on local availability of parts and service for all items bid and service literature to allow for in-house maintenance and repairs
7. **Bid Submittal:**
   A. The bid must be signed in ink and delivered to Purchasing by the *"Due Date & Time."* The bid number must appear on the outside of the envelope. **Fax bids will not be accepted**.
   B. Bids, modifications, or corrections received after the closing time on the *"Due Date"* will be considered late.
   C. All purchases are subject to Riverton City purchasing ordinance.
8. **Warranties:**
   Contractor warrants that all equipment, and/or materials, and/or labor that is furnished or performed will be free from defects for a minimum period of twelve (12) months from date of acceptance. Upon notice from the City of any defect during the applicable warranty period, the affected item, parts or work shall be redone, redesigned, repaired or replaced by contractor (at contractor's expense) at a time acceptable to the City.
9. **Conformance Warranty:**
   Vendor warrants the item(s) bid will conform to the description as bid, and applicable specifications, and shall be of good and merchantable quality for the known purpose for which it is sold.
10. **Bid Evaluation:**
    Any item bid is subject to evaluation. Any item which fails to qualify for approval when evaluated shall not be accepted regardless of compliance to bid requirements. Bids ***will not be accepted from vendors who require assignment of payment to another agent.*** **Note:** ***Riverton City will only pay the vendor named on the order. Riverton City will not deal with a factor or make payment to such.***
11. **Collusion:**
    The vendor agrees and certifies that there has been no collusion or other anticompetitive practices. If any are suspected among bidders or offerors, a notice of the relevant facts shall be transmitted to the attorney general.
12. **Antidiscrimination Act:**
    The vendor agrees to abide by the provisions of the Utah Antidiscrimination Act, Title 34 Chapter 35, U.C.A. 1953, as amended, and Title VI and Title VII of the Civil Rights Act of 1964 (USC 2000e), which prohibit discrimination against any employee or applicant for employment, or any applicant or recipient of services, on the basis of race, religion, color, or national origin: and further agrees to abide by Executive Order No. 11246, as amended, which prohibits discrimination on the basis of sex: 45 CFR 90 which prohibits discrimination on the basis of age, and Section 504 of the Rehabilitation Act of 1973, which prohibits discrimination on the basis of handicap. This purchase may be canceled if the vendor fails to comply with the provisions of these laws and regulations. **Vendor must include this provision in every subcontract or purchase order relating to purchases by Riverton City to insure that subcontractors and vendors are bound by this provision.**