JORDAN VALLEY WATER CONSERVANCY DISTRICT

Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah 84088
Project Manager: Kevin Rubow, P.E. (801) 565-4300

BIDDING REQUIREMENTS AND CONTRACT DOCUMENTS VOLUME 1 OF 3 APRIL 2023

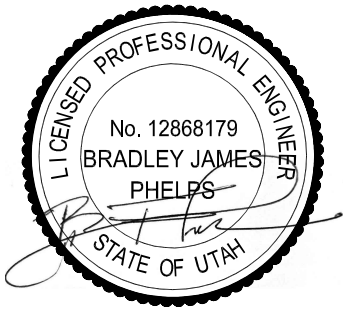
for the construction of the

11800 SOUTH ZONE C RESERVOIRS

JVWCD Project No. 4276

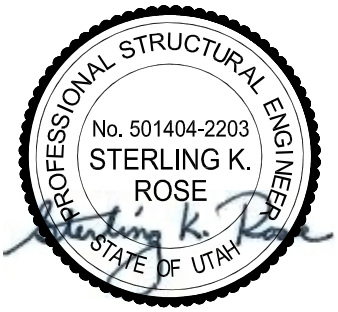
JACOBS®

Jacobs Engineering
6440 South Millrock Drive, Suite 300
Holladay, UT 84121
Project Engineer: Ryan Willeitner, P.E. (385) 474-8564



DIGITALLY SIGNED: 04/12/2024
Brad Phelps, P.E.

DIGITALLY SIGNED: 04/12/2024
Ryan Willeitner, P.E.



DIGITALLY SIGNED: 04/12/2024
Sterling Rose, S.E.

Project No. W7Y49600

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END OF SECTION

BIDDING REQUIREMENTS

NOTICE INVITING BIDS

PROJECT NAME: 11800 South Zone C Reservoir

DESCRIPTION OF WORK: The Work of this Contract comprises the construction of the 11800 South Zone C Reservoirs and generally includes construction of two 5 MG drinking water reservoirs. The Owner intends to award a single contract for construction of the Project. The Work generally includes the following:

- Construction of two 5 MG reservoirs that are constructed to a Type I, AWWA D110 Wire Wound, Circular, Prestressed Concrete Water Tank standard.
- Construction of buried vaults, yard piping improvements, and connections to transmission piping.
- Construction of a chlorine chemical feed building.
- Excavation to construct the new tank within the limits of the site; backfill and grading; management of contaminated soils within select areas of the site; construction of new access roads, and other site improvements.
- New reservoir instrumentation and controls. Update electrical service feeds.
- Site landscaping.

DISTRICT WEB SITE AND PLANHOLDERS LIST
Prospective bidders must register at the District's web site (www.jvwcd.org) under "Engineering Projects". Prospective bidders are required to check the District's web site for any addenda prior to submitting a responsive bid. The District's web site will be used to publish updated information relative to the project, including a planholders list.

RECEIPT OF BIDS: Sealed bids will be received at the administration office of the Jordan Valley Water Conservancy District, Owner of the Work, located at 8215 South 1300 West, West Jordan, Utah 84088, until **2:00 PM on Tuesday, May 21, 2024**, for construction of the "11800 South Zone C Reservoirs". Electronic bids may also be submitted in adobe .pdf format to ellisad@jvwcd.org. JVWCD requests that electronic bids be submitted 15 minutes prior to the bid opening deadline. A public bid opening will be held at the bid due time. Attendance is not required. Bid results will be posted to the District's website within 24 hours of the bid opening.

OBTAINING CONTRACT DOCUMENTS: The Contract Documents are entitled, "11800 South Zone C Reservoirs". All Contract Documents may be obtained, online at www.jvwcd.org under "Engineering Projects".

OPENING OF BIDS: The bids will be publicly opened and read at the time and location identified above.

SITES OF WORK: The work is located at 7271 West 11800 South, South Jordan, Utah.

NOTICE INVITING BIDS

PRE-BID MEETING: A **mandatory** pre-bid meeting will be held at **10:00 AM on Monday, April 29, 2024,** beginning at the office of the Owner. Prequalified General Contractors must notify the Owner if they are unable to attend the pre-bid meeting, so that alternative pre-bid meeting arrangements can be made. There will be a non-mandatory site visit directly following the pre-bid meeting.

PREQUALIFIED CONTRACTORS: The Owner authorized use of a prequalification procedure to determine and select General Contractors eligible to bid and construct the Project. Based upon the qualification submittals received in response to the District's Invitation for Contractor Prequalification Submittals, only the following General Contractors are prequalified to bid and construct the Project. Only Prequalified General Contractors shall be allowed to submit Bids on this Contract.

Gerber Construction

MGC Contractors

ProBuild Construction

Ralph L. Wadsworth Construction

Skaar Construction

COMPLETION OF WORK: All work shall be Substantially Complete by **May 1, 2026**.

AWARD OF CONTRACT: An Award of Contract, if it were awarded, will be made within 60 calendar days of the opening of bids.

NOTICE TO PROCEED: A Notice to Proceed, if it were issued, will be made within 60 calendar days of the Notice of Award.

BID SECURITY: Each bid shall be accompanied by a certified or cashier's check, money order or bid bond in the amount of five percent of the total bid price payable to the Jordan Valley Water Conservancy District as a guarantee that the bidder, if its bid is accepted, will promptly execute the contract, provide evidence of worker's compensation insurance, and furnish a satisfactory faithful performance bond in the amount of 100 percent of the total bid price and a payment bond in the amount of 100 percent of the total bid price.

ADDRESS AND MARKING OF BID: The envelope enclosing the bid shall be sealed and addressed to the Jordan Valley Water Conservancy District and delivered or mailed to 8215 South 1300 West, West Jordan, Utah 84088. The envelope shall be plainly marked in the upper left-hand corner with the name and address of the bidder and shall bear the words "Bid for," followed by the title of the Contract Documents for the work and the date and hour of opening of bids. The certified or cashier's check, money order, or bidder's bond shall be enclosed in the same envelope with the bid. Electronic bids shall be submitted to the engineering administrative assistant, ellisad@jvwcd.org as an email

attachment with the words “Bid for,” followed by the title of the Contract Documents for the work and the date and hour of opening of bids in the subject line of the email.

PROJECT ADMINISTRATION: All questions relative to this project prior to the opening of bids shall be directed to the Engineer for the project. It shall be understood, however, that no interpretations of the specifications will be made by telephone, nor will any "or equal" products be considered for approval prior to award of contract.

ENGINEER
Jacobs Engineering
6440 South Millrock Drive, Suite 300
Holladay, Utah 84121
Telephone: (385) 474-8564
Project Engineer: Ryan Willeitner, P.E.
Email: ryan.willeitner@jacobs.com

OWNER'S RIGHTS RESERVED: The Owner reserves the right to reject any or all bids, to waive any informality in a bid, and to make awards in the interest of the Owner.

OWNER
Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah 84088
(801) 565-4300
Project Manager: Kevin Rubow, P.E.
Email: KevinR@jvwcd.org

JORDAN VALLEY WATER CONSERVANCY DISTRICT

INSTRUCTIONS TO BIDDERS

FORM OF BID: The bid shall be made on the bidding schedule(s) bound herein. The bid shall be enclosed in a sealed envelope bearing the name of the bidder and name of the project. In the event there is more than one bidding schedule, the bidder may bid on any individual schedule or on any combination of schedules.

DELIVERY OF BID: The bid shall be delivered by the time and to the place stipulated in the Notice Inviting Bids. It is the bidder's sole responsibility to see that his bid is received in proper time.

WITHDRAWAL OF BIDS: Bids shall be unconditionally accepted without alteration or correction, excepting that bidder may by means of written request, signed by the bidder or his properly authorized representative withdraw his bid. Such written request must be delivered to the place stipulated in the Notice Inviting Bids for receipt of bids prior to the scheduled closing time for receipt of bids.

OPENING OF BIDS: The bids will be publicly opened and read at the time and place stipulated in the Notice Inviting Bids.

MODIFICATIONS AND ALTERNATIVE BIDS: Unauthorized conditions, limitations, or provisions attached to a bid may render it non-responsive and may cause its rejection. The completed bid forms shall be without interlineations, alterations, or erasures. Alternative bids will not be considered unless called for. Oral, telegraphic, or telephonic bids or modifications will not be considered.

DISCREPANCIES IN BIDS: In the event there is more than one bid item in a bidding schedule, the bidder shall furnish a price for all bid items in the schedule; failure to do so may render the bid non-responsive and subject to rejection. In the event there are unit price bid items in a bidding schedule and the "amount" indicated for a unit price bid item does not equal the product of the unit price and quantity, the unit price shall govern and the "amount" will be corrected accordingly, and the Contractor shall be bound by said Correction. In the event there is more than one bid item in a bidding schedule and the total indicated for the schedule does not agree with the sum of the prices bid on the individual items, the prices bid on the individual items shall govern and the total for the schedule will be corrected accordingly, and the Contractor shall be bound by said correction.

BID SECURITY: Each bid shall be accompanied by a certified or cashier’s check or approved bid bond in the amount stated in the Notice Inviting Bids. Said check or bond shall be made payable to the Owner and shall be given as a guarantee that the bidder, if awarded the work, will enter into a contract within 10 calendar days after receipt of the contract from the Owner, and will furnish the necessary insurance certificates, Payment Bond, and Performance Bond; each of said bonds to be in the amount stated in the Notice

Inviting Bids. In case the apparent low bidder refuses or fails to enter into such contract or fails to provide the required insurance and insurance certificates, the check or bid bond, as the case may be, shall be forfeited to the Owner. If the bidder elects to furnish a bid bond as his bid guarantee, he shall use the bid bond bound herein, or one conforming substantially to it in form.

QUALIFICATIONS OF BIDDERS: To demonstrate Bidder's qualifications to perform the Work, Bidder shall submit with its Bid (a) written evidence establishing its qualifications, previous experience, and (b) the following additional information:

1. Section E – Information Required of Bidder.

A Bidder's failure to submit the required information, and/or failure to meet the specific qualification and experience requirements of the Project, will render a Bid non-responsive and disqualify Bidder from receiving an award of the Contract.

BIDDER'S EXAMINATION OF CONTRACT DOCUMENTS AND SITE

It is the responsibility of each Bidder before submitting a Bid to:

1. Examine Contract Documents thoroughly.

2. Visit the site to become familiar with local conditions that may affect cost, progress, performance, or furnishing of the work.

3. Consider federal, state and local laws and regulations that may affect cost, progress, and performance of furnishing of the work.

4. Study and carefully correlate the Bidder's observations with the Contract Documents.

5. Notify the Engineer of all conflicts, errors, or discrepancies in the Contract Documents.

Reference is made to the Supplemental General Conditions for identification of:

1. Those reports of exploration and tests of subsurface conditions at the site, which have been utilized by the Engineer in the preparation of the Contract Documents.

2. Those drawings of physical conditions in or relating to existing surface and subsurface conditions (except underground utilities as defined in Article 1 of the General Conditions) which are at or contiguous to the site and which

were utilized by the Engineer in the preparation of the Contract Documents. Copies of such reports and drawings are available for inspection at the office of the Owner.

Information and data reflected in the Contract Documents with respect to underground facilities at/or contiguous to the site are based upon information and data furnished to the Owner and the Engineer by the owners of such underground facilities or others, and the Owner does not assume any responsibility for the accuracy or completeness thereof including any damages whatsoever that may be incurred by the Bidder or the Contractor through his reliance thereon unless it is expressly provided otherwise in the Supplemental General Conditions and/or the Technical Specifications.

Before submitting a bid, the bidder shall conduct such examination, investigations, studies and tests as are necessary to satisfy himself as to: the nature and location of the physical conditions (surface, subsurface and underground facilities), the general and local conditions particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, availability of utilities, local weather conditions, the character of equipment and facilities required preliminary to and during the prosecution of the work; any and all other conditions that may in any way affect the cost, progress, performance or furnishing of materials in accordance with the Contract Documents. All such examination, investigation, studies, tests and the like shall be at the Bidder's expense.

Upon reasonable request in advance, the Owner shall provide each Bidder access to the site to conduct such explorations, examination, investigation and tests as each Bidder may determine necessary for the submission of a Bid. The Bidder shall fill all holes, clean and restore the site to its former condition upon the completion of such activities.

The submission of a bid hereunder shall be considered prima facie evidence that the Bidder has made such examination as is set forth in the above paragraph and is knowledgeable as to the location and site conditions surrounding the work and the conditions to be encountered in performing the work and as to the requirements, conditions and terms of the Contract and Contract Documents.

The Owner assumes no responsibility for any understanding or representations made by any of its officers or agents during or prior to the execution of this Contract, for information contained in any reports, subsurface studies, or other information which may be made available for the Contractor's information and which are not included as Contract Documents, for any understanding or representations by the Owner or by others which are not expressly stated in the Contract Documents which liability is not expressly assumed by the Owner or its representatives or Engineer in the Contract Documents. Such information shall be deemed to be for the information of the Contractor and the

Contractor shall have the obligation of evaluating any such information as to its accuracy and effect the Owner will not be liable or responsible for any such information or any conclusions that may be drawn there from by the Contractor.

The lands upon which the work is to be performed, right-of-ways and easements for access thereto together with other lands designated for use by the Contractor in performing the work are identified in the Contract Documents. All additional lands and access thereto that are required for temporary construction facilities or storage of materials and equipment are to be provided by the Contractor. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by the Owner unless otherwise provided in the Contract Documents.

The submission of a Bid shall constitute an incontrovertible representation by the Bidder that the Bidder has complied with every requirement of this Article, and that without exception the Bid is premised upon performing and furnishing the work required by the Contract Documents in compliance with such means, methods, techniques, sequences, or procedures of construction as may be indicated in or required by the Contract Documents; and that such means, methods, techniques, sequences or procedures described in the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing the work.

QUANTITIES OF WORK: The quantities of work or material stated in the Bid Schedule are supplied only to give an indication of the general scope of the work; the Owner does not expressly or by implication agree that the actual amount of work or material will correspond therewith. The Owner reserves the right after award of the Contract to increase or decrease the quantities of any unit price item of the work by an amount up to and including 25 percent of the quantity of any bid item, or to omit portions of such work as may be deemed necessary or expedient by the Engineer or Owner, without a change in the unit price. Such right to revise and omit shall include the right to delete any bid item in its entirety, or to add additional bid items in quantities up to and including an aggregate total amount not to exceed 25 percent of the total amount of the Contract.

The Bidders nor the ultimate Contractor on the Project shall at any time after the submittal of a bid make or have any claim for damages or anticipated profits or loss of profit or otherwise because of any difference between the quantities of work actually done and material furnished and those stated in said unit price items of the Bid.

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.

After an award of the contract no substitution of the Project Manager or Project Superintendent will be allowed without the written approval by the Owner.

DISQUALIFICATION OF BIDDERS: More than one bid from an individual, firm partnership, corporation, or association under the same or different names will not be considered. Reasonable grounds for believing that any bidder is interested in more than one bid for the work contemplated will cause the rejection of all bids in which such bidder is interested. If there is reason for believing that collusion exists among the bidders, all bids will be rejected.

RETURN OF BID GUARANTEE: Within 10 calendar days after award of the contract, the Owner will return the bid guarantees accompanying such of the bids as are not considered in making the award. All other bid guarantees will be held until a Notice to Proceed has been issued and accepted. They will then be returned to the respective bidders whose bids they accompany.

EVALUATION OF BIDS: In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid or prior to the Notice of Award. In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents. Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

AWARD OF CONTRACT: Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unqualified, unbalanced, or conditional Bids. Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, then the Owner will reject the Bid as nonresponsive; provided that Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work.

If Owner awards a contract for the Work, such award shall be to the qualified Bidder submitting the lowest responsive Bid. Any such award will be made by written notice and within 60 calendar days after opening of the bids, unless a different waiting period is

expressly allowed in the Notice Inviting Bids. The Owner intends to award a single contract for construction of the Project. Individual schedules will not be awarded separately.

EXECUTION OF CONTRACT: The Bidder to whom the award is made shall secure all insurance and shall furnish all certificates and bonds required by the specifications within ten calendar days after receipt of the Notice of Award from the Owner. The Bidder to whom the award is made shall execute a written contract with the Owner on the form of agreement provided within ten calendar days after receipt of the Agreement from the Owner. Failure or refusal to enter into a contract as herein provided or to conform to any of the stipulated requirements in connection therewith shall be just cause for annulment of the award and forfeiture of the bid guarantee. If the successful bidder refuses or fails to execute the contract, the Owner may award the contract to the second lowest responsible bidder, or reject all bids and re-advertise the project for rebidding. If the second lowest responsible bidder refuses or fails to execute the contract, the Owner may award the contract to the third lowest responsible bidder. On the failure or refusal of such second or third lowest bidder to execute the contract, each such bidder's guarantees shall be likewise forfeited to the Owner.

ISSUANCE OF NOTICE TO PROCEED: The Owner intends to execute the Agreement and issue the Notice to Proceed specifying the Project start date within ten calendar days after its receipt of the executed Agreement, Purchase Order Assignment(s), (if applicable), bonds and insurance certificates from the successful bidder. If the Contract Time is expressed as a specific completion date in the Notice Inviting Bids and paragraph 3.1 of the Agreement rather than a specific number of successive days following the start date identified in the Notice to Proceed, then any delay by the Owner beyond the ten days in issuing the Notice to Proceed shall extend the completion date by the number of days of the delay.

LICENSES: Contractor must be licensed as a business qualified to do business within the state of Utah prior to issuance of a Notice of Award. Contractor must hold a current contractor’s license with classifications appropriate to the work being contracted.

STATE REGISTRY: The Contractor shall register the project, if awarded, on the State of Utah Construction Registry prior to the commencement of the work.

BID

BID TO: JORDAN VALLEY WATER CONSERVANCY DISTRICT

The undersigned Bidder hereby proposes to furnish all plant machinery, labor, services, materials, equipment, tools, supplies, transportation, utilities, and all other items and facilities necessary to perform all work required under the Bidding Schedule of the Owner's Contract Documents entitled “11800 South Zone C Reservoirs” drawings and all addenda issued by said Owner prior to opening of the bids.

Addenda, if issued, are only delivered by e-mail to those on Owner’s website (jvwcd.org) Plan Holders List.

The undersigned bidder acknowledges receipt of the following addenda:

No.	Date Received	No.	Date Received

Bidder agrees that, within 10 calendar days after receipt of Notice of Award from Owner, he will execute the Agreement in the required form, of which the Notice Inviting Bids, Instructions to Bidders, Bid, Information Required of Bidder, Technical Specifications, Drawings, and all addenda issued by Owner prior to the opening of bids, are a part, and will secure the required insurance and bonds and furnish the required insurance certificates; and that upon failure to do so within said time, then the bid guarantee furnished by Bidder shall be forfeited to Owner as liquidated damages for such failure; provided, that if Bidder shall execute the Agreement, secure the required insurance and bonds, and furnish the required insurance certificates within said time, his check, if furnished, shall be returned to him within five days thereafter, and the bid bond, if furnished, shall become void. It is further understood that this bid may not be withdrawn for a period of 45 days after the date set for the opening thereof, unless otherwise required by law.

Dated: _____ Bidder: _____

By: _____
(Signature)

Title: _____

Bidder further agrees to complete all work required within the time stipulated in the Contract Documents, and to accept in full payment therefore the price(s) named in the above-mentioned Bidding Schedule(s).

BASIS OF BID

Award of the Contract will be based upon the total bid price for the Contract. The Bid Schedule consists of lump sum and unit price bid amounts. The Total Lump Sum Bid Price is the sum of these figures plus any increased amount the Contractor determines necessary to complete the entire project based on the Work shown in the Contract Documents that may not be included as an individual bid item in the Schedule of Bid Items.

This Bid Schedule contains the schedule of prices which will be incorporated into the Agreement by reference. The determination of the low bidder will be based on Bid Schedule A.

Bid Schedule - A				
	Description	**Quantity Unit**	**Unit Price**	**Amount**
A1.	General Conditions Including Bidder's Insurance and Mobilization, Demobilization & Administration	LS		
A2.	5 MG AWWA D110 Reservoir	2 EA		
A3.	All Yard Piping and Pipes Inside the Reservoirs	LS		
A4.	Valve Vault Concrete Structure and All Facilities Inside the Structure	LS		
A5.	Chlorine Building	LS		
A6.	Other Minor Structures; Drainage Vault, Leak Detection Box, Overflow Junction, Catch Basins, Storm Drain Manhole, Drainage Outlet at Midas Creek	LS		
A7.	Electrical and Instrumentation Work	LS		
A8.	Contaminated Soil Mitigation	LS		
A9.	General Site Grading, Landscape, Hydroseeding, Revegetation, Fencing and Other Site Improvements	LS		
A10.	Roadway Installation	LS		
A11.	Permit Fee Allowance	Allowance	$25,000	$25,000
A12.	Other Misc Items	LS		

Bid Schedule A1 through A12 = $_____

Proposal Adjustment: The proposed adjustment allows the Bidder to adjust their bid just

prior to bid opening without the need to adjust individual bid item amounts. The sum of the extended total shall be increased or (decreased) by this Proposal Adjustment amount. Indicate decrease in parenthesis (_____). For payment purposes, this correction amount will be applied to Schedule Item A2 proportionally to the amount bid for this bid item.

Proposal Adjustment: **$**_____

Total Adjusted Bid Schedule A: **$**_____

Bidder agrees to accept as full payment for Work proposed with the Bidding Documents based upon the undersigned's own estimate of quantities and costs and including sales, consumer, use, other taxes, and overhead and profit, the following amount for the Contract:

_____Dollars

And _____Cents

Bidder (Company name): _____

By: _____ Dated: _____
(Signature)

Name: _____ Title: _____

ATTACHMENTS TO THIS BID

The following documents are attached to and made a condition of this Bid:

1. Required Bid security in the form of Bid Bond.
2. Information Required of Bidder.

BID BOND

KNOW ALL MEN BY THESE PRESENTS,

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

WHEREAS, Principal has submitted a bid to Owner to perform all work required under the bidding Schedule of the Owner's Contract Documents entitled “11800 South Zone C Reservoirs”, (hereafter called the “Project”).

NOW THEREFORE, if Principal is awarded Contract by Owner for the Construction of the Project and, within the time and in the manner required under the heading "Instructions to Bidders" enters into the written contract entitled "Agreement" bound with said Contract Documents, furnishes the required certificates of insurance, and furnishes the required Performance Bond and Payment Bond within 10 calendar days after receipt of such contract from Owner, 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 Owner and judgment is recovered, Surety shall pay all costs incurred by Owner in such suit, including a reasonable attorney's fee to be fixed by the court.

SIGNED AND SEALED, this __day of _____, 20__.

_____	_____
By: _____	By: _____
President	
Its: _____	Its: _____
(SEAL)	(SEAL)

INFORMATION REQUIRED OF BIDDER

The Bidder shall furnish the following information. Failure to comply with this requirement may render the Bid non-responsive and subject to rejection. Additional sheets shall be attached as required.

1. Contractor's name: _____

2. Contractor's address: _____
   _____
   _____

   Contractor's Primary Contact: _____
   Email address of Contractor's primary contact: _____
   Contractor's telephone number: _____

3. Contractor must be qualified and licensed to do business in Utah.
   Utah Department of Commerce Information
   Business Entity Number: _____
   Delinquent Date: _____

4. Contractor license Information:
   Contractor's Utah License Number: _____
   Expiration Date: _____
   Primary Classification: _____
   Supplemental Classification held, if any: _____

5. Name and title of officers of Contractor's firm:

   _____

   _____

   _____

6. Number of persons employed full-time by the firm: _____

7. Name of person who inspected site of proposed work for your firm:

   Name: _____

   Date of Inspection: _____

INFORMATION REQUIRED OF BIDDER

8. Surety company who will provide the required bonds on this contract: _____

   Agent's Name:_____

   Telephone:_____

10. Workers Compensation Insurance Policy #: _____

11. Name of Project Manager: As per Pre-qualification Documents previously submitted. Any substitutions will be considered only after project award. _____

12. Name of Project Superintendent: As per Pre-qualification Documents previously submitted. Any substitutions will be considered only after project award. _____

CONTRACTING REQUIREMENTS

CONTRACTING FORMS

AGREEMENT

An Agreement made as of the _____ day of _____, 20___, by and between the Jordan Valley Water Conservancy District, a Utah special district ("OWNER"), and _____, a _____ corporation qualified to do business and doing business in the State of Utah ("CONTRACTOR").

TERMS:

OWNER and CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE I
WORK

CONTRACTOR shall complete all Work as specified or indicated in the Contract Documents for the _____. The Work is generally described as follows:

> Furnishing all labor, services, materials, equipment, and supplies except for such materials, equipment, and services as may be stipulated in the Contract Documents to be furnished by the OWNER; furnishing and removing all plant machinery, temporary structures, tools, supplies, transportation, utilities, and all other items, facilities and equipment, and to do everything required by this Agreement and the Contract Documents; accepting all responsibility for and paying 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 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 Contract Documents are expressly stipulated to be borne by OWNER.

ARTICLE II
ENGINEER

The Project has been designed by the OWNER. The OWNER will assume all duties and responsibilities and have the rights and authority assigned to ENGINEER in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

[ALTERNATE PARAGRAPH]The Project has been designed by _____, a _____ corporation qualified to do business and doing business in the State of Utah, who is hereinafter called "ENGINEER" and who is to act as OWNER's representative, assume all duties and responsibilities and have the rights and

authority assigned to ENGINEER in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

ARTICLE III
CONTRACT TIME

3.1 The Work shall be complete, in accordance with paragraphs 14.08 and 14.09 of the General Conditions, on or before _____.

3.2 Liquidated Damages: OWNER and CONTRACTOR recognize that time is of the essence of this Agreement and that the OWNER will suffer financial loss if the Work is not completed within the time specified in paragraph 3.1 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by OWNER if the Work is not completed on time. Accordingly, instead of requiring any proof of loss, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay OWNER the amount specified in Article 14.07 of the General Conditions and in Article 18.01 of the Supplementary General Conditions for each day that expires after the time specified in paragraph 3.1 for final completion until the Work is substantially complete. And, after Substantial Completion if CONTRACTOR neglects, refuses or fails to complete the remaining Work within forty-five (45) days or any proper extension thereof granted by OWNER, CONTRACTOR shall pay OWNER the amount specified in Article 14.07 of the General Conditions and in Article 18.01 of the Supplemental General Conditions for each day that expires after the forty-five (45) days until readiness for final payment.

ARTICLE IV
CONTRACT PRICE

All payments to Contractor shall be made in accordance with the Contract Documents. OWNER shall pay CONTRACTOR for completion of the Work in accordance with the Contract Documents in current funds those prices stated in the approved Bid Schedule as named in the Notice of Award.

ARTICLE V
PAYMENT PROCEDURES

CONTRACTOR shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by ENGINEER as provided in the General Conditions.

5.1 Progress Payments: OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment

as recommended by ENGINEER, on a monthly basis. All progress payments will be on the basis of the progress of the Work measured by the schedule of values established in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Conditions.

5.2 Final Payment: Upon final completion and acceptance of the Work in accordance with Article 14 of the General Conditions, OWNER shall pay the remainder of the Contract Price as recommended by ENGINEER as provided in Article 14.

ARTICLE VI
INTEREST

All moneys not paid when due as provided in Article 14 of the General Conditions shall bear interest at the rate of twelve percent (12%) per annum.

ARTICLE VII
CONTRACTOR'S REPRESENTATION

In order to induce OWNER to enter into the Agreement, CONTRACTOR makes the following representations:

7.1 CONTRACTOR has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

7.2 CONTRACTOR has studied carefully all exploration reports and test of subsurface conditions and drawings of physical conditions which are identified in the Supplementary General Conditions, as provided in paragraph 4.02 of the General Conditions, and accepts the Technical Data contained in such reports and drawings upon which CONTRACTOR is entitled to rely.

7.3 CONTRACTOR has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests, reports and studies (in addition to or to supplement those referred to in paragraph 7.2 above) which pertain to the subsurface or physical conditions at or contiguous to the site or otherwise may affect the cost, progress, performance or furnishing of the Work as CONTRACTOR considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of paragraph 4.02 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports,

studies or similar information or data are or will be required by CONTRACTOR for such purposes.

7.4 CONTRACTOR has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities.

7.5 CONTRACTOR has correlated the results of all observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

7.6 CONTRACTOR has given ENGINEER written notice of all conflicts, errors or discrepancies that he had discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

ARTICLE VIII
CONTRACT DOCUMENTS

The Contract Documents for the _____, which comprise the entire agreement between OWNER and CONTRACTOR concerning the Work, consist of the following:

8.1 This Agreement;
8.2 Performance and Payment Bonds;
8.3 Notice of Award;
8.4 Notice to Proceed;
8.5 General Conditions;
8.6 Supplemental General Conditions;
8.7 Notice Inviting Bids;
8.8 Instructions to Bidders;
8.9 Information Required of Bidder;
8.10 Technical Specifications;
8.11 Drawings - Sheets Number One through _____;
8.12 Addendum Number One through _____; and,
8.13 CONTRACTOR's Bid, including all schedules and explanatory attachments; attached as Exhibit A.

The CONTRACTOR (1) acknowledges that he has received a copy of each document, specified above, (2) acknowledges that he has read and understands each document specified above and (3) agrees to every term, condition and contract obligation set forth in each document specified above.

There are no Contract Documents other than those listed above in this Article 8. The Contract Documents may only be amended, modified or supplemented as provided in paragraphs 3.03 of the General Conditions.

ARTICLE IX
FEDERAL REQUIREMENTS

The CONTRACTOR shall comply with federal regulations as stated in the Supplemental General Conditions, Article 21.

ARTICLE X
MISCELLANEOUS

10.1 Terms used in this Agreement which are defined in Article 1 of the General Conditions will have the meanings indicated in the General Conditions.

10.2 No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.3 In the event any legal action or other proceeding is brought for the enforcement of this Agreement and/or the Contract Documents, or for damages, because of an alleged dispute, breach, default or misrepresentation in connection with any of the provisions thereof, the successful or prevailing party shall be entitled to recover reasonable attorneys' fees and other costs incurred in the action or proceeding, in addition to any other relief to which it may be entitled.

10.4 Any notice to be given hereunder shall be deemed given when sent by registered or certified mail, postage prepaid to the parties at their respective addresses stated below or at any other address when notice of such change of address has been given as provided in this Article 10.4.

[SIGNATURE PAGE FOLLOWS]

"OWNER":	"CONTRACTOR":
Jordan Valley Water Conservancy District 8215 South 1300 West West Jordan, Utah 84088	_____ _____ _____ Utah License No. _____
By: _____ Alan E. Packard Its General Manager/CEO	By: _____ Its: _____

EXHIBIT A

CONTRACTOR'S BID

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS,

That _____, as Contractor, and as Surety, are held firmly bound unto the Jordan Valley Water Conservancy District hereinafter called "Owner," in the sum of $_____ 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, Contractor has been awarded and is about to enter into the annexed Agreement with Owner to perform all work required under the Bidding Schedule(s) of the Owner's Contract Documents entitled “11800 South Zone C Reservoirs".

NOW THEREFORE, if Contractor shall perform all the requirements of the Agreement 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 full force and effect.

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 the Agreement, shall not in any way release Contractor or Surety thereunder, nor shall any extensions of the time granted under the provisions of the Agreement release either the Contractor or Surety, and notice of such alterations or extensions of the work, materials or time to complete made under the Agreement is hereby waived by Surety. This Bond is furnished in compliance and in accordance with 14-1-18, Utah Code Ann., as amended, and 63-56-38 Utah Code Ann., as amended.

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

_____	_____
By: _____	By: _____
Its: _____	Its: _____
(SEAL)	(SEAL)

(SEAL AND NOTARIAL ACKNOWLEDGMENT OF SURETY)

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS,

That _____ as Contractor, and as Surety, are held firmly bound unto the Jordan Valley Water Conservancy District hereinafter called "Owner," in the sum of $_____ 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, Contractor has been awarded and is about to enter into the annexed Agreement with Owner to perform all work required under the Bidding Schedule(s) of the Owner's Contract Documents entitled, “11800 South Zone C Reservoirs”.

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, 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 the Agreement, shall not in any way release Contractor or Surety thereunder, nor shall any extensions of time granted under the provisions of said contract release either Contractor or the Surety, and notice of such alterations or extensions of the work, materials or time to complete made under the Agreement is hereby waived by Surety. This bond is furnished in compliance and in accordance with 14-1-18 and 19 Utah Code Ann., as amended, and 63-56-38 Utah Code Ann., as amended.

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

_____	_____
By: _____	By: _____
Its:	Its:
(SEAL)	(SEAL)

(SEAL AND NOTARIAL ACKNOWLEDGMENT OF SURETY)

NOTICE OF AWARD

To: [Insert Contractor's Name and Address]

Re: 11800 South Zone C Reservoirs

You are hereby notified that the OWNER has accepted your bid for the above referenced project in the amount of $_____.

Furnish the required Contractor's Performance Bond, Payment Bond and Certificates of Insurance within ten calendar days from the date of this notice to you. An acknowledged copy of this Notice of Award, together with all future correspondence regarding this project, shall be sent to the District's Project Manager: Kevin Rubow

When the Agreement is provided, sign and return it within ten calendar days from receipt of the agreement.

Dated this ____ day of _____, 20___.

_____
Shane Swensen, PE
Chief Engineer

ACCEPTANCE OF NOTICE

Receipt of the above Notice of Award is hereby acknowledged by:

_____

This _____ day of _____, 20___.

Signature: _____

Printed Name: _____

Title: _____

NOTICE TO PROCEED

To: [Insert Contractor's Name and Address]

Re: 11800 South Zone C Reservoirs

You are hereby notified to commence work in accordance with the Agreement dated _____, and you are to complete the work by, _____.

An acknowledged copy of this Notice to Proceed should be returned to the Owner, Attention: Kevin Rubow, Senior Engineer.

Dated this _____ day of _____.

_____
Travis P. Christensen, P.E.
Engineering Group Leader

ACCEPTANCE OF NOTICE

Receipt of the above Notice to Proceed is hereby acknowledged by:

_____

This _____ day of _____, 20___.

Signature:_____

Printed Name:_____

Title: _____

JORDAN VALLEY WATER CONSERVANCY DISTRICT

PAYMENT APPLICATION AND CERTIFICATE No. ___ DATE: _____

SHEET _____ OF _____

PERIOD FROM _____ TO _____, 20___

PROJECT: 11800 South Zone C Reservoirs

JVWCD PROJECT NO.: 4276

CONTRACTOR: _____

ADDRESS: _____

ENGINEER:

JVWCD

1. ORIGINAL CONTRACT PRICE:..... $_____

2. NET CHANGE ORDERS APPROVED TO DATE: ..... $_____
(Attach Summary Sheet)

3. REVISED CONTRACT AMOUNT: ..... $_____
(Sum of Lines 1 & 2)

4. TOTAL VALUE OF WORK COMPLETED TO DATE ... . $_____
(Attached Payment Breakdown)

5. PERCENT PROJECT COMPLETE: ..... _____%
(Divide Line 4 by 3 and multiply by 100)

6. LESS AMOUNT RETAINED (5%) ..... $_____

7. MATERIALS ON HAND..... $_____
(95% of Value, Listing Attached)

8. SUBTOTAL (Sum of Lines 4, Line 6 and Line 7)..... $_____

9. LESS PREVIOUS PAYMENTS ..... $_____

10. CURRENT PAYMENT DUE: ..... $_____
(Line 8 & 9)

JORDAN VALLEY WATER CONSERVANCY DISTRICT

Payment Application and Certificate No _____

SHEET _____ OF _____

CONTRACTOR'S Certification:

The undersigned CONTRACTOR certifies that: (1) all previous progress payments received from OWNER on account of work done under the Contract referred to herein have been applied to discharge in full all obligations of CONTRACTOR incurred in connection with work covered by prior Applications for Payment numbered 1 through _____ inclusive; and, (2) title to all materials and equipment incorporated in said Work or otherwise listed in or covered by this Application for Payment will pass to OWNER at time of payment free and clear of all liens, claims, security interests and encumbrances (except such as covered by bond acceptable to OWNER).

Dated: _____ CONTRACTOR: _____

By: _____

Engineer's Recommendation:

This Application (with accompanying documentation) meets the requirements of the Contract Documents and payment of the amount due this application is recommended.

ENGINEER

Dated: _____ _____

Project Representative

Dated: _____ _____

Project Manager

JORDAN VALLEY WATER CONSERVANCY DISTRICT

CHANGE ORDER

Change Order No. _____

Date: _____

Page ___ of ___

PROJECT NAME: 11800 South Zone C Reservoirs

PROJECT NUMBER: 4276

CONTRACTOR: _____

CONTRACT DATE: _____

The following changes are hereby made to the CONTRACT DOCUMENTS:

1)

2)

3)

Total Change to CONTRACT PRICE: ..... $

Original CONTRACT PRICE: ..... $

Current CONTRACT PRICE adjusted by previous CHANGE ORDER(S)..... $

The new CONTRACT PRICE including this CHANGE ORDER will be ..... $

The CONTRACT TIME will be increased by _____ calendar days.

The date for Substantial Completion will be _____, 20___.

The Contractor agrees to furnish all labor and materials and perform all work as necessary to complete the change order items for the price named herein, which includes all supervision and miscellaneous costs. This change order constitutes full and mutual accord and satisfaction for all time and all costs related to this change. By acceptance of this change order the Contractor agrees that the change order represents an equitable adjustment to the Contract, and further agrees to waive all right to file a claim arising out of or as a result of this change. This document will become a supplement to the Contract, and all provisions will apply hereto, upon approval by the Owner.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

CHANGE ORDER
(CONTINUED)

Change Order No. _____

Date: _____

Page ___ of ___

Recommended:

Engineer – Jacobs Engineering	Date

Accepted:

Contractor –	Date

Approved:

Owner - Jordan Valley Water Conservancy District	Date

JORDAN VALLEY WATER CONSERVANCY DISTRICT

CONTRACTOR'S CERTIFICATE
OF
SUBSTANTIAL COMPLETION

OWNER	ENGINEER
TO: Jordan Valley Water Conservancy District 8215 South 1300 West West Jordan, Utah 84088-0070	Jacobs Engineering 6440 South Millrock Drive, Suite 300 Holladay, Utah 84121

PROJECT: 11800 South Zone C Reservoirs

ATTENTION: _____

FROM: _____
Firm or Corporation

This is to certify that I,_____ am an authorized official of working in the capacity of_____
_____and have been properly authorized by said firm or corporation to sign the following statements pertaining to the subject contract:

I know of my own personal knowledge, and do hereby certify, that the work of the contract described above has been substantially performed and all materials used and installed to date are in accordance with, and in conformity to, the contract drawings and specifications. A list of all incomplete work is attached.

The Contractor hereby releases the Owner and its agents from all claims of and liability to the Contractor for anything done or furnished for or relating to the work, as further provided in Article 14.08B of the General Conditions, except demands against the Owner for the remainder of progress payments retained to date, and unresolved written claims prior to this date.

The contract work is now substantially complete, ready for its intended use, and ready for your inspection. You are requested to issue a Certificate of Substantial Completion.

SIGNATURE: _____

DATE: _____

JORDAN VALLEY WATER CONSERVANCY DISTRICT

CONTRACTOR'S CERTIFICATE
OF
FINAL COMPLETION

OWNER	ENGINEER
TO: Jordan Valley Water Conservancy District 8215 South 1300 West West Jordan, Utah 84088-0070	Jacobs Engineering 6440 Millrock Drive, Suite 300 Holladay, Utah 84121

PROJECT: 11800 South Zone C Reservoirs

ATTENTION: Project Representative: _____

FROM: _____
Firm or Corporation

This is to certify that I, _____ am an authorized official of _____ working in the capacity of_____ _____and have been properly authorized by said firm or corporation to sign the following statements pertaining to the subject contract:

I know of my own personal knowledge, and do hereby certify, that the work of the contract described above has been performed and all materials used and installed to date are in accordance with, and in conformity to, the contract drawings and specifications.

The Contract work is now complete in all parts and requirements, excepting the attached list of minor deficiencies and the reasons for each being incomplete to date, for which exemption from final payment requirements is requested in conformance to Article 14.09A of the General Conditions of our Contract (if no exemptions requested, write "none") _____. The work is now ready for your final inspection. The following items required from the Contractor prior to application for final payment (such as O & M Manuals, guarantees, record drawings, etc.) are submitted herewith, if any:

_____

_____

JORDAN VALLEY WATER CONSERVANCY DISTRICT

I understand that neither the issuance by the Engineer of a Notice of Completion, nor the acceptance thereof by the Owner, shall operate as a bar or claim against the Contractor under the terms of the guarantee provisions of the Contract Documents.

SIGNATURE:

_____

DATE:

_____

JORDAN VALLEY WATER CONSERVANCY DISTRICT

CONSENT OF SURETY FOR FINAL PAYMENT

PROJECT NAME: 11800 South Zone C Reservoirs

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 Representatives)

_____
(Title)

JORDAN VALLEY WATER CONSERVANCY DISTRICT

AFFIDAVIT OF PAYMENT

To All Whom It May Concern:

WHEREAS, the undersigned has been employed by the Jordan Valley Water Conservancy District to furnish labor and materials under a contract dated _____ for the project entitled "11800 South Zone C Reservoirs", in the County of Salt Lake, State of Utah, of which Jordan Valley Water Conservancy District is the Owner.

NOW, THEREFORE, this _____ day of _____, 20__, the undersigned, as the Contractor for the above-named Contract pursuant to the Conditions of the Contract 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: _____

GENERAL CONDITIONS OF THE CONTRACT

ARTICLE 1 - DEFINITIONS

Wherever used in these General Conditions or in the other Contract Documents the following terms have the meanings indicated:

Addenda - Written or graphic instruments issued prior to the opening of Bids which make additions, deletions, or revisions to the Contract Documents.

Agreement - The written contract between the OWNER and the CONTRACTOR for the performance of the WORK pursuant to the Contract Documents. Documents incorporated into the contract by reference become part of the contract and of the Agreement.

Application for Payment - The form furnished by the ENGINEER and completed by the CONTRACTOR to request progress or final payment including supporting documentation to substantiate the amounts for which payment is requested.

Bonds - Performance, and Payment Bonds and other instruments which protect against loss due to inability or refusal of the CONTRACTOR to perform pursuant to the Contract Documents.

Change Order - A document recommended by the ENGINEER, which is signed by the CONTRACTOR and the OWNER and authorizes an addition, deletion, or revision in the WORK, or an adjustment in the Contract Price or the Contract Time, issued on or after the Effective Date of the Agreement.

Contract Documents - Information and Instructions, forms (including the Schedule of Prices and all required certificates and affidavits), Agreement, Performance Bond, Payment Bond, General Conditions, Supplemental General Conditions, Technical Specifications, Drawings and all Addenda and Change Orders executed pursuant to the provisions of the Contract Documents.

Contract Price - The total monies payable by the OWNER to the CONTRACTOR under the terms and conditions of the Contract Documents.

Contract Time - The number of successive Days stated in the Contract Documents for the completion of the WORK. The Contract Time begins to run on the date specified in the Notice to Proceed.

CONTRACTOR - The person, firm, or corporation with whom the OWNER has executed the Agreement.

Cost Proposal - The offer or proposal of the pipeline installation subcontractor to the CONTRACTOR to provide the work required under these Contract Documents.

Day - A calendar day of 24 hours measured from midnight to the next midnight.

Defective Work - Work that: is unsatisfactory, faulty, or deficient; does not conform to the Contract Documents; does not meet the requirements of any inspection, reference standard, test, or approval referred to in the Contract Documents; has been damaged prior to the ENGINEERS's recommendation of final payment.

Drawings - The drawings, plans, maps, profiles, diagrams, and other graphic representations which show the character, location, nature, extent, and scope of the WORK.

Effective date of the Agreement - The date indicated in the Agreement on which it was executed, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

ENGINEER - The person, firm, or corporation named as such in the Contract Documents.

Field Order - A written order issued by the ENGINEER which may or may not involve a change in the WORK.

Laws and Regulations; Laws or Regulations - Laws, rules, regulations, ordinances, codes, and/or orders promulgated by a lawfully constituted body authorized to issue such Laws and Regulations.

Notice of Award - The OWNER's written notice to the apparent successful Bidder stating that upon compliance with the conditions precedent enumerated therein by the apparent successful Bidder within the time specified, the OWNER will enter into the Agreement.

Notice to Proceed - The OWNER's written notice to the CONTRACTOR authorizing the CONTRACTOR to proceed with the work and establishing the date of commencement of the Contract Time.

OWNER - The Jordan Valley Water Conservancy District.

Partial Utilization - Placing a portion of the WORK in service for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion of the WORK.

Project - A unit of total construction of which the WORK to be provided under the Contract Documents, may be the whole, or a part thereof.

Project Representative - The authorized representative of the ENGINEER who is assigned to the site or any part thereof.

Proposer - Any person, firm or corporation submitting a proposal for the work.

Schedule of Prices - The offer or proposal of the CONTRACTOR setting forth the price or prices for the work to be performed.

Shop Drawings - All drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for the CONTRACTOR to illustrate some portion of WORK and all illustrations, brochures, standard schedules, performance charts, instruction, and diagrams to illustrate material or equipment for some portion of the WORK.

Specifications - (Same definition as for Technical Specifications hereinafter).

Subcontractor - An individual, firm, or corporation having a direct contract with the CONTRACTOR or with any other Subcontractor for the performance of a part of the WORK at the site.

Substantial Completion - That state of construction when the WORK has progressed to the point where, in the opinion of the ENGINEER as evidenced by the Certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the WORK can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to any work refer to substantial completion thereof.

Supplementary General Conditions - The part of the Contract Documents which make additions, deletions, or revisions to these General Conditions.

Supplier - A manufacturer, fabricator, supplier, distributor, materialman, or vendor.

Technical Data - The factual information contained in reports describing physical conditions, including exploration method, plans, logs, laboratory test methods and factual data. Technical Data does not include conclusions, interpretations, interpolations, extrapolations or opinions contained in reports or reached by the CONTRACTOR.

Technical Specifications - Those portions of the Contact Documents consisting of the written technical descriptions of products and execution of the WORK.

Underground Utilities - All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments and any encasements containing such facilities which have been installed under ground to furnish any of the following services or

materials: water, sewage and drainage removal, electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, traffic, or other control systems.

WORK - The entire construction required to be furnished under the Contract Documents. WORK is the result of performing services, furnishing labor and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.

GENERAL CONDITIONS

ARTICLE 2 - PRELIMINARY MATTERS

2.01 DELIVERY OF BONDS/INSURANCE CERTIFICATES

A. The CONTRACTOR shall deliver to the OWNER the Agreement, Bonds, Insurance Policies and Certificates required by the Contract Documents within ten (10) days after receiving the Notice of Award from the OWNER.

2.02 COPIES OF DOCUMENTS

A. The OWNER shall furnish the CONTRACTOR 5 copies of the Contract Documents, together with 5 sets of full-scale Drawings. Additional quantities of the Contract Documents will be furnished at reproduction cost.

2.03 STARTING THE PROJECT

A. The CONTRACTOR shall begin construction of the WORK within 10 days after the commencement date stated in the Notice to Proceed, but shall not commence construction prior to the commencement date.

2.04 BEFORE STARTING CONSTRUCTION

A. Before undertaking each part of the WORK, the CONTRACTOR shall carefully study and compare the Contract Documents to check and verify pertinent figures and dimensions shown thereon with all applicable field measurements. The CONTRACTOR shall promptly report in writing to the ENGINEER any conflict, error, or discrepancy which the CONTRACTOR may discover and shall obtain a written interpretation or clarification from the ENGINEER before proceeding with any work affected thereby.

B. The CONTRACTOR shall submit to the ENGINEER for review those documents called for in each section of the Technical Specifications.

2.05 PRECONSTRUCTION CONFERENCE

A. The CONTRACTOR shall attend a preconstruction conference with the OWNER, the ENGINEER and others as appropriate to discuss the construction of the WORK in accordance with the Contract Documents.

2.06 FINALIZING SCHEDULES

A. At least 7 days before the CONTRACTOR's submittal of its first Application for Payment, the CONTRACTOR, the ENGINEER, and others as appropriate will meet to finalize the schedules submitted in accordance with the Technical Specifications.

GENERAL CONDITIONS

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 INTENT

A. The Contract Documents comprise the entire agreement between OWNER and CONTRACTOR concerning the WORK. The Contract Documents are complementary, what is called for by one is as binding as if called for by all. The Contract Documents will be construed in accordance with the law of the place of the Project.

B. It is the intent of the Contract Documents to describe the WORK, functionally complete, to be constructed in accordance with the Contract Documents. All work, materials, or equipment that may be reasonably inferred from the Contract Documents as being required to produce the completed work shall be supplied whether or not specifically called for. When words which have a well-known technical or trade meaning are used to describe work, materials, or equipment such words shall be interpreted in accordance with that meaning. Reference to standard specifications, manuals, or codes or any technical society, organization, or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids, except as may be otherwise specifically stated. However, no provision of any referenced standard specification, manual, or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change the duties and responsibilities of the OWNER, the CONTRACTOR, or the ENGINEER or any of their consultants, agents, or employees from those set forth in the Contract Documents.

C. If, during the performance of the WORK, the CONTRACTOR finds a conflict, error or discrepancy in the Contract Documents, the CONTRACTOR shall immediately report it to the ENGINEER in writing and before proceeding with the work affected thereby. The ENGINEER shall then make a written interpretation, clarification, or correction from the ENGINEER.

3.02 ORDER OF PRECEDENCE OF CONTRACT DOCUMENTS

A. In resolving conflicts resulting from conflicts, errors, or discrepancies in any of the Contract Documents, the order of precedence shall be as follows:

1. Change Orders
2. Agreement
3. Addenda
4. Contractor's Bid (Bid Form)
5. Supplemental General Conditions
6. Notice Inviting Bids
7. Instructions to Bidders
8. General Conditions
9. Technical Specifications
10. Referenced Standard Specifications
11. Drawings

B. With reference to the Drawings the order of precedence is as follows:

1. Figures govern over scaled dimensions
2. Detail drawings govern over general drawings
3. Addenda/change order drawings govern over general drawings
4. Contract Drawings govern over standard drawings

3.03 AMENDING AND SUPPLEMENTING CONTRACT DOCUMENTS

A. The Contract Documents may be amended by a Change Order (pursuant to Article 10) to provide for additions, deletions or revisions in the WORK or to modify terms and conditions.

3.04 REUSE OF DOCUMENTS

A. Neither the CONTRACTOR, Subcontractor, Supplier, nor any other person or organization performing any of the WORK under a contract with the OWNER shall have or acquire any title to or ownership rights in any of the Drawings, Technical Specifications, or other documents used on the WORK, and they shall not reuse any of them on the extensions of the Project or any other project without written consent.

GENERAL CONDITIONS

ARTICLE 4 - AVAILABILITY OF LANDS; PHYSICAL CONDITIONS: REFERENCE POINTS

4.01 AVAILABILITY OF LANDS

A. The OWNER shall furnish the lands, rights-of-way and easements upon which the WORK is to be performed and for access thereto, together with other lands designated for the use of the CONTRACTOR in the Contract Documents. Easements for permanent structures or permanent changes in existing major facilities will be obtained and paid for by the OWNER, unless otherwise provided in the Contract Documents. Nothing contained in the Contract Documents shall be interpreted as giving the CONTRACTOR exclusive occupancy of the lands or rights-of-way provided. The CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment. The CONTRACTOR shall not enter upon nor use any property not under the control of the OWNER until a written temporary construction easement agreement has been executed by the CONTRACTOR and the property owner, and a copy of the easement furnished to the ENGINEER prior to its use. Neither the OWNER nor the ENGINEER shall be liable for any claims or damages resulting from the CONTRACTOR's unauthorized trespass or use of any properties.

4.02 PHYSICAL CONDITIONS - SUBSURFACE AND EXISTING STRUCTURES

A. Explorations and Reports: The paragraph entitled "Physical Conditions" of the Supplementary General Conditions identifies exploration reports and subsurface conditions tests at the site that have been utilized by the ENGINEER in the preparation of the Contract Documents. The CONTRACTOR may rely upon the accuracy of the Technical Data contained in these reports. The CONTRACTOR is responsible for the interpretation, extrapolation or interpolation of all technical as well as nontechnical data and its reliance on the completeness, opinions and interpretation of the reports.

B. Existing Structures: The paragraph entitled "Physical Conditions" of the Supplementary General Conditions identifies the drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Utilities referred to in Paragraph 4.04 herein) which are at or contiguous to the site that have been utilized by the ENGINEER in the preparation of the Contract Documents. The CONTRACTOR is responsible for the interpretation, extrapolation or interpolation of all technical as well as nontechnical data and its reliance on the completeness, opinions and interpretation of the reports.

4.03 DIFFERING SITE CONDITIONS

A. The CONTRACTOR shall notify the ENGINEER upon encountering any of the following unforeseen conditions, hereinafter called "differing site conditions," during the prosecution of the WORK. The CONTRACTOR's notice to the ENGINEER shall be in writing and delivered before the differing site conditions are disturbed, but in no event later than 14 days after their discovery.

1. Subsurface or latent physical conditions at the site of the WORK differing materially from those indicated, described, or delineated in the Contract Documents including those reports and documents discussed in Paragraph 4.02; and

2. Physical conditions at the site of the WORK of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents including those reports and documents discussed in Paragraph 4.02.

B. The ENGINEER will review the alleged differing site conditions, determine the necessity of obtaining additional explorations or tests with respect to verifying their existence and extent and advise the OWNER in writing of the ENGINEER's findings and conclusions.

C. If the OWNER concludes that because of newly discovered conditions a change in the Contract Documents is required, a Change Order will be issued as provided in Article 10 to reflect and document the consequences of the differing site conditions.

D. In each such case, an increase or decrease in the Contract Price or an extension or shortening of the Contract Time, or any combination thereof, will be allowable to the extent that they are attributable to the differing site conditions. If the OWNER and the CONTRACTOR are unable to agree as to the amount or length of the Change Order, a claim may be made as provided in Articles 11 and 12.

E. The CONTRACTOR's failure to give written notice of differing site conditions within 14 days of their discovery and before they are disturbed shall constitute a waiver of all claims in connection therewith, whether direct or consequential in nature.

4.04 PHYSICAL CONDITIONS - UNDERGROUND UTILITIES

A. Shown or Indicated: The information and data shown or indicated in the Contract Documents with respect to existing Underground Utilities at or contiguous to the site are based on information and data furnished to the OWNER or the ENGINEER by the owners of Underground Utilities or by others. Unless it is expressly provided in the Supplementary General Conditions and/or the Section entitled "Protection and Restoration of Existing Facilities" of the Technical Specifications, the OWNER and the ENGINEER shall not be responsible for the accuracy or completeness of any Underground Utilities information or data. The CONTRACTOR's responsibility relating to underground utilities are: review and check all information and data, locate all Underground Utilities shown or indicated in the Contract Documents, coordinate the WORK with the owners of Underground Utilities during construction, the safeguard and protect the of Underground Utilities, and repair any damage to Underground Utilities resulting from the WORK. The cost of all these activities will be considered as having been included in the Contact Price.

B. Not Shown or Indicated: If an Underground Utility not shown or indicated in the Contract Documents is uncovered or revealed at or contiguous to the site and which the CONTRACTOR could not reasonably have been expected to be aware of, the CONTRACTOR shall give written notice to the OWNER of that utility and the ENGINEER, specifying the location of the utility in question.

4.05 REFERENCE POINTS

A. The ENGINEER will provide one bench mark, near or on the site of the WORK, and will provide two points near or on the site to establish a base line for use by the ENGINEER for alignment control. Unless otherwise specified in the Technical Specifications, the CONTRACTOR shall furnish all other lines, grades, and bench marks required for proper execution of the WORK.

B. The CONTRACTOR shall preserve all bench marks, stakes, and other survey marks. In case of their removal or destruction by its own employees or by its subcontractor's employees, the CONTRACTOR shall be responsible for the accurate replacement of reference points by professionally qualified personnel at no additional cost to the OWNER.

GENERAL CONDITIONS

ARTICLE 5 - BONDS AND INSURANCE

5.01 PERFORMANCE AND OTHER BONDS

A. The CONTRACTOR shall furnish Performance and Payment Bonds, each in the amount set forth in the Supplementary General Conditions as security for the faithful performance and payment of all the CONTRACTOR's obligations under the Contract Documents. All insurance companies, sureties, and bond companies shall have an AM Best rating of A- or better, with a Financial Size Category of XII or better. Sureties shall also be listed on the Department of the Treasury's Circular 570, with an acceptable underwriting limitation limit. The Performance Bond shall remain in effect at least until one year after the date of Notice of Completion, except as otherwise provided by Law or Regulation or by the Contract Documents. After the ENGINEER issues the Notice of Completion, the amount of the Performance Bond may be reduced to 10 percent of the Contract Price, or $1,000, whichever is greater. The CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary General Conditions.

B. If the surety on any Bond furnished by the CONTRACTOR is declared a bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the WORK is located, the CONTRACTOR shall within 7 days after written approval by the OWNER of a substitute Bond and Surety substitute the approved Bond and Surety.

5.02 INSURANCE

A. The CONTRACTOR shall purchase and maintain the insurance required under this paragraph. All insurance companies, sureties, and bond companies shall have an AM Best rating of A- or better, with a Financial Size Category of XII or better. Sureties shall also be listed on the Department of the Treasury's Circular 570, with an acceptable underwriting limitation limit. This insurance shall include the specific coverages set out herein and be written for not less than the limits of liability and coverages provided in the Supplementary General Conditions, or required by law, whichever is greater. The CONTRACTOR's liabilities under the Agreement shall not be deemed limited in any way to the insurance coverage required.

B. The CONTRACTOR shall furnish the OWNER and ENGINEER with certificates indicating the type, amount, class of operations covered, effective dates and expiration dates of all policies. All insurance policies purchased and maintained (or the certificates or other evidence thereof) shall contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 30 days' prior written

notice has been given to the OWNER by certified mail. All insurance shall remain in effect until the ENGINEER issues the Notice of Completion and at all times thereafter when the CONTRACTOR may be correcting, removing, or replacing defective work in accordance with Paragraph 13.06 or completing punch list items required by the Notice of Completion. In addition, the insurance required herein (except for Worker's Compensation and Employer's Liability) shall name the OWNER, the ENGINEER, and their officers, agents, and employees as "additional insured" under the policies.

1. Workers' Compensation and Employer's Liability: This insurance shall protect the CONTRACTOR against all claims under applicable state workers' compensation laws. The CONTRACTOR shall also be protected against claims for injury, disease, or death of employees which, for any reason, may not fall within the provisions of a workers' compensation law. This policy shall include an "all states" endorsement. The CONTRACTOR shall require each subcontractor similarly to provide Workers' Compensation Insurance for all of the latter's employees to be engaged in the WORK unless its employees are covered by the protection afforded by the CONTRACTOR's Workers' Compensation Insurance. In the event a class of employees is not protected under the Workers' Compensation Statute, the CONTRACTOR or Subcontractor, as the case may be, shall provide adequate employer's liability insurance for the protection of its employees not protected under the statute.

2. Comprehensive General Liability: This insurance shall be written in comprehensive form and shall protect the CONTRACTOR against all claims arising from injuries to persons other than its employees and damage to property of the OWNER or others arising out of any act or omission of the CONTRACTOR or its agents, employees or subcontractors. The policy shall include the following endorsements: (1) Protective Liability endorsement to insure the contractual liability assumed by the CONTRACTOR under the indemnification provisions in these General Conditions; (2) Broad Form Property Damage endorsement; (3) Personal Injury endorsement to cover personal injury liability for intangible harm. The Comprehensive General Liability coverage shall contain no exclusion relative to blasting, explosion, collapse of building, or damage to underground structures.

3. Comprehensive Automobile Liability: This insurance shall be written in comprehensive form. The policy shall protect the CONTRACTOR against all claims for injuries to employees, members of the public and

damage to property of others arising from the use of CONTRACTOR's motor vehicles, whether they are owned, non-owned, or hired, and whether used or operated on or off the site. The motor vehicle insurance required under this paragraph shall include: (a) motor vehicle liability coverage; (b) personal injury protection coverage and benefits; and (c) uninsured motor vehicle coverage.

4. Subcontractor's Insurance: The CONTRACTOR shall require each of its subcontractors to procure and to maintain Comprehensive General Liability Insurance and Comprehensive Automobile Liability Insurance of the type and in the amounts specified in the Supplementary General Conditions or insure the activities of its subcontractors in the CONTRACTOR's own policy, in like amount.

5. Builder's Risk: This insurance shall be of the "all risk" type, shall be written in completed value form, and shall protect the CONTRACTOR, the OWNER, and the ENGINEER against damage to buildings, structures, materials and equipment. The amount of this insurance shall not be less than the insurable value of the WORK at completion. Builder's risk insurance shall provide for losses to be payable to the CONTRACTOR, the OWNER, and the ENGINEER as their interests may appear. The policy shall contain a provision that in the event of payment for any loss under the coverage provided, the insurance company shall have no rights of recovery against the CONTRACTOR, the OWNER, and the ENGINEER. The Builder's Risk policy shall insure against all risks of direct physical loss or damage to property from any external cause including flood and earthquake. Allowable exclusions, if any, shall be as specified in the Supplementary General Conditions.

GENERAL CONDITIONS

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 SUPERVISION AND SUPERINTENDENCE

A. The CONTRACTOR shall supervise and direct the WORK competently and efficiently, devoting the attention and applying the skills and expertise necessary to perform the WORK in accordance with the Contract Documents. The CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction and safety precautions and programs incidental thereto. The CONTRACTOR shall be responsible to see that the finished WORK complies accurately with the Contract Documents.

B. The CONTRACTOR shall employ the Superintendent named in "Information Required of Bidder" on the work site at all times during the progress of the WORK. The superintendent shall not be replaced without the OWNER's written consent. The superintendent will be the CONTRACTOR's representative at the site and shall have authority to act on behalf of the CONTRACTOR. All communications given to the superintendent shall be as binding as if given to the CONTRACTOR. The CONTRACTOR shall issue all its communications to the OWNER through the ENGINEER.

C. The CONTRACTOR's superintendent shall be present at the site of the WORK at all times while work is in progress. Failure to observe this requirement shall be considered suspension of the WORK by the CONTRACTOR until the superintendent is again present at the site.

6.02 LABOR, MATERIALS, AND EQUIPMENT

A. The CONTRACTOR shall provide skilled, competent and suitably qualified personnel to survey and lay out the WORK and perform construction as required by the Contract Documents. When required in writing by the OWNER or ENGINEER, the CONTRACTOR or any subcontractor shall discharge any person who is, in the opinion of the OWNER or ENGINEER, incompetent, disorderly, or otherwise unsatisfactory and shall not again employ the discharged person on the WORK without the consent of the OWNER or ENGINEER. The CONTRACTOR shall at all times maintain good discipline and order at the site.

B. Except in connection with the safety or protection of persons the WORK, or property at the site or adjacent thereto, all work at the site shall be performed during regular working hours, and the CONTRACTOR will not permit overtime work or the performance of work on Saturday, Sunday or any legal holiday without the OWNER's written consent given after prior written notice

to the ENGINEER. Except as otherwise provided in this Paragraph, the CONTRACTOR shall receive no additional compensation for overtime work, i.e., work in excess of 8 hours in any one calendar day or 40 hours in any one calendar week, even though such overtime work may be required under emergency conditions and may be ordered by the ENGINEER in writing. Additional compensation will be paid the CONTRACTOR for overtime work in the event extra work is ordered by the ENGINEER and the Change Order specifically authorizes the use of overtime work, but only to the extent that the CONTRACTOR pays overtime wages on a regular basis being paid by for overtime work of a similar nature in the same locality.

C. All costs of inspection and testing performed during overtime work approved solely for the convenience of the CONTRACTOR shall be borne by the CONTRACTOR. The OWNER shall have the authority to deduct the costs of all inspection and testing from any partial payments otherwise due to the CONTRACTOR.

D. Unless otherwise specified in the Contract Documents, the CONTRACTOR shall furnish, erect, maintain and remove the construction plant, and temporary works and assume full responsibility for all materials, equipment, labor, transportation, construction equipment, machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities and all other facilities and incidentals necessary for the furnishing, performance testing, start-up and completion of the WORK.

E. All materials and equipment incorporated into the WORK shall be of new and good quality, except as otherwise provided in the Contract Documents. If required by the ENGINEER, the CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. The CONTRACTOR shall apply, install, connect, erect, use, clean, and condition all material and equipment in accordance with the instructions of the manufacturer and Supplier except as otherwise provided in the Contract Documents.

6.03 ADJUSTING PROGRESS SCHEDULE

A. The CONTRACTOR shall submit any adjustments in the progress schedule to the ENGINEER for acceptance in accordance with the provisions for "Contractor Submittals" in the Technical Specifications.

6.04 SUBSTITUTES OR "OR-EQUAL" ITEMS

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or “or-equal” item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to ENGINEER for review under the circumstances described below:

1. “Or-Equal” Items: If in ENGINEER’s sole discretion an item of material or equipment proposed by CONTRACTOR is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by ENGINEER as an “or-equal” item, in which case review and approval of the proposed item may, in ENGINEER’s sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this paragraph 6.04.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment ENGINEER determines that: (i) it is a least equal in quality, durability, appearance, strength, and design characteristics; (ii) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole, and;

b. CONTRACTOR certifies that: (i) there is no increase in cost to the OWNER; and (ii) it will conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Document.

2. Substitute Items

a. If in ENGINEER’s sole discretion an item of material or equipment proposed by CONTRACTOR does not qualify as an “or-equal” item under paragraph 6.04.A.1, it will be considered a proposed substitute item.

b. CONTRACTOR shall submit sufficient information as provided below to allow ENGINEER to determine that the item of material or

equipment proposed is essentially equivalent to that named and an acceptable substitute therefore. Requests for review of proposed substitute items of material or equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR.

c. The procedure for review by ENGINEER will be as set forth in paragraph 6.04.A.2.d, as supplemented in the Technical Specifications and as ENGINEER may decide is appropriate under the circumstances.

d. CONTRACTOR shall first make written application to ENGINEER for review of a proposed substitute item of material or equipment that CONTRACTOR seeks to furnish or use. The application shall certify that the proposed substitute item will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified, and be suited to the same use as that specified. The application will state the extent, if any, to which the use of the proposed substitute item will prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not use of the proposed substitute item will require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute item, and whether or not incorporation or use of the substitute item is subject to payment of any license fee or royalty. All variations of the proposed substitute item from that specified will be identified in the application, and available engineering, sales, maintenance, repair, and replacement services will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change, all of which will be considered by ENGINEER in evaluating the proposed substitute item. ENGINEER may require CONTRACTOR to furnish additional data about the proposed substitute item.

B. Substitute Construction Methods or Procedures: If a specific means, method, technique, sequence, or procedure of construction is shown or indicated in and expressly required by the Contract Documents, CONTRACTOR may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by ENGINEER. CONTRACTOR shall submit sufficient information to allow ENGINEER, in

ENGINEER's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by ENGINEER will be similar to that provided in subparagraph 6.04.A.2.

C. Engineer's Evaluation: ENGINEER will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to paragraphs 6.04.A and 6.04.B. ENGINEER will be the sole judge of acceptability. No "or-equal" or substitute will be ordered, installed or utilized until ENGINEER's review is complete, which will be evidenced by either a Change Order for a substitute or an approved Shop Drawing for an "or equal." ENGINEER will advise CONTRACTOR in writing of any negative determination.

D. Special Guarantee: OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any substitute.

E. ENGINEER's Cost Reimbursement: ENGINEER will record time required by ENGINEER and ENGINEER's Consultants in evaluating substitute proposed or submitted by CONTRACTOR pursuant to paragraphs 6.04.A.2 and 6.04.B and in making changes in the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) occasioned thereby. Whether or not ENGINEER approves a substitute item so proposed or submitted by CONTRACTOR, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's Consultants for evaluation each such proposed substitute.

F. CONTRACTOR's EXPENSE: CONTRACTOR shall provide all data in support of any proposed substitute or "or-equal" at CONTRACTOR's expense.

6.05 CONCERNING SUBCONTRACTORS, SUPPLIERS, AND OTHERS

A. The CONTRACTOR shall be responsible to the OWNER and the ENGINEER for the acts and omissions of its subcontractors and their employees to the same extent as the CONTRACTOR is responsible for the acts and omissions of its own employees. Nothing contained in this paragraph shall create any contractual relationship between any subcontractor and the OWNER or the ENGINEER nor relieve the CONTRACTOR of any liability or obligation under the Agreement.

6.06 PERMITS

A. Unless otherwise provided in the Supplementary General Conditions, the CONTRACTOR shall obtain and pay for all construction permits and licenses from the agencies having jurisdiction, including furnishing the insurance and bonds required by such agencies. The costs incurred by the CONTRACTOR in compliance with this paragraph shall not be made the basis for claims for additional compensation. The OWNER shall assist the CONTRACTOR, when necessary, in obtaining such permits and licenses. The CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the WORK, which are applicable at the time of opening of Bids, including all utility connection charges for utilities required by the WORK.

B. The CONTRACTOR shall pay all license fees and royalties and assume all costs when any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others when issued in the construction of the WORK or incorporated into the WORK. If a particular invention, design, process, product, or device is specified in the Contract Documents for incorporation into or use in the construction of the WORK and if to the actual knowledge of the OWNER or the ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of these rights shall be disclosed by the OWNER in the Contract Documents. The CONTRACTOR shall indemnify, defend and hold harmless the OWNER and the ENGINEER and anyone directly or indirectly employed by either of them from and against all claims, damages, losses, and expenses (including attorneys' fees and court costs) arising out of any infringement of patent rights or copyrights incident to the use in the performance of the WORK or resulting from the incorporation in the WORK of any invention, design, process, product, or device not specified in the Contract Documents.

6.07 LAWS AND REGULATIONS

A. The CONTRACTOR shall observe and comply with all federal, state, and local laws, ordinances, codes, orders, and regulations which in any manner affect those engaged or employed on the WORK, the materials used in the WORK, or the conduct of the WORK. If any discrepancy or inconsistency should be discovered in the Contract Documents in relation to any law, ordinance, code, order, or regulations, the CONTRACTOR shall report the same in writing to the ENGINEER. The CONTRACTOR shall indemnify, defend and hold harmless the OWNER, the ENGINEER and their officers, agents, and employees against all claims and from violation of any law, ordinance, code, order, or regulation, whether by CONTRACTOR or by its employees or subcontractors. Any particular law or regulation specified or

referred to elsewhere in the Contract Documents shall not in any way limit the obligation of the CONTRACTOR to comply with all other provisions of federal, state, and local laws and regulations. Where an individual State act on occupational safety and health standards has been approved by Federal authority, then the provision of said State act shall control.

6.08 EQUAL OPPORTUNITY

A. The Contractor agrees to abide by: the provisions of Title VII of the Civil Rights Act of 1964 (42USC § § 2000e et seq.), which prohibits discrimination against any employee or applicant for employment on the basis of race, religion, color, or national origin; 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; Section 504 of the Rehabilitation Act of 1973, (42 USC § 794), which prohibits discrimination on the basis of handicap; Utah Executive Order dated June 30, 1989, which prohibits sexual harassment in the workplace; and the Americans with Disabilities Act (42 USC § § 12111 et seq.), which prohibits discrimination against qualified employees and applicants with a disability.

6.09 TAXES

A. The CONTRACTOR shall pay all sales, consumer, use, and other similar taxes required to be paid by the CONTRACTOR in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the WORK.

6.10 USE OF PREMISES

A. The CONTRACTOR shall confine construction equipment, stored materials and equipment, and other operations of workers to (1) the Project site, (2) the land and areas identified for the CONTRACTOR's use in the Contract Documents, and (3) other lands whose use is acquired by Laws and Regulations, rights-of-way, permits, and easements. The CONTRACTOR shall be fully responsible to the owner and occupant of such lands for any damage to the lands or areas contiguous thereto, resulting from the performance of the WORK or otherwise. Should any claim be made against the OWNER or the ENGINEER by owner or occupant of lands because of the performance of the WORK, the CONTRACTOR shall promptly settle the claim by agreement, or resolve the claim through litigation. The CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, indemnify, defend, and hold the OWNER and the ENGINEER harmless from and against all claims, damages, losses, and expenses (including, but not limited to, fees of engineers, architects, attorneys, and other professionals and court costs) arising directly, indirectly, or consequentially out of any action, legal or equitable, brought by any owner or occupant of land against the OWNER or the ENGINEER to the extent the claim is based or arises out of the CONTRACTOR's performance of the WORK.

6.11 SAFETY AND PROTECTION

A. The CONTRACTOR shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the WORK. The CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. All employees on the WORK and other persons and organizations who may be affected thereby.

2. All the WORK and materials and equipment to be incorporated therein, whether in storage on or off the site; and

3. Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

B. The CONTRACTOR shall comply with all applicable Laws and Regulations (whether referred to herein or not) of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury, or loss and shall erect and maintain all necessary safeguards for such safety and protection. The CONTRACTOR shall notify owners of adjacent property and utilities when prosecution of the WORK may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. Unless the CONTRACTOR otherwise designates in writing a different individual as the responsible individual, the CONTRACTOR's superintendent shall be CONTRACTOR's representative at the site whose duty shall be the prevention of accidents.

6.12 SHOP DRAWINGS AND SAMPLES

A. After checking and verifying all field measurements and after complying with the applicable procedures specified in the Technical Specifications, the CONTRACTOR shall submit all shop drawings to the ENGINEER for review and approval in accordance with the approved schedule for shop drawings submittals specified in the Technical Specifications.

B. The CONTRACTOR shall also submit to the ENGINEER for review and approval all samples in accordance with the approved schedule of sample submittals specified in the Technical Specifications.

C. Before submitting shop drawings or samples, the CONTRACTOR shall determine and verify all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar data with respect thereto and review or coordinate each shop drawing or sample with other shop drawings and samples and with the requirements of the WORK and the Contract Documents.

6.13 CONTINUING THE WORK

A. The CONTRACTOR shall carry on the WORK and adhere to the progress schedule during all disputes or disagreements with the OWNER. No work shall be delayed or postponed pending resolution of any dispute or disagreement, except as the CONTRACTOR and the OWNER may otherwise mutually agree in writing.

6.14 INDEMNIFICATION

A. To the fullest extent permitted by Laws and Regulations, the CONTRACTOR shall indemnify, defend, and hold harmless the OWNER, the ENGINEER, and their officers, agents, and employees, against and from all claims and liability arising under or by reason of the Agreement or any performance of the WORK, but not from the sole negligence or willful misconduct of the OWNER and/or the ENGINEER. Such indemnification by the CONTRACTOR shall include but not be limited to the following:

1. Liability or claims resulting directly or indirectly from the negligence or carelessness of the CONTRACTOR or its agents in the performance of the WORK, or in guarding or maintaining the same, or from any improper materials, implements, or appliances used in its construction, or by or on account of any act or omission of the CONTRACTOR or its agents;

2. Liability or claims arising directly or indirectly from or based on the violation of any law, ordinance, regulation, order, or decree, whether by the CONTRACTOR or its agents;

3. Liability or claims arising directly or indirectly from the use or manufacture by the CONTRACTOR, its agents, or the OWNER in the performance of this Agreement of any copyrighted or uncopyrighted composition, secret process, patented or unpatented invention, article, or appliance, unless otherwise specifically stipulated in this Agreement.

4. Liability or claims arising directly or indirectly from the breach of any warranties, whether express or implied, made to the OWNER or any other parties by the CONTRACTOR or its agents;

5. Liabilities or claims arising directly or indirectly from the willful misconduct of the CONTRACTOR or its agents; and,

6. Liabilities or claims arising directly or indirectly from any breach of the obligations assumed herein by the CONTRACTOR.

B. The CONTRACTOR shall reimburse the OWNER, and the ENGINEER for all costs and expense, (including but not limited to fees and charges of engineers, architects, attorneys, and other professional and court costs) incurred by the OWNER, and the ENGINEER in enforcing the provisions of this Paragraph.

C. The indemnification obligation under this Paragraph shall not be limited in any way by any limitation of the amount or type of damages, compensation, or benefits payable by or for the CONTRACTOR or any such subcontractor or other person or organization under workers' compensation acts, disability benefit acts, or other employee benefit acts.

6.15 CONTRACTOR'S DAILY REPORTS

A. The CONTRACTOR shall complete a daily report indicating manpower, major equipment, subcontractors, weather conditions, etc., involved in the performance of the WORK. The daily report shall be completed on forms prepared by the CONTRACTOR and acceptable to the ENGINEER, and shall be submitted to the ENGINEER at the conclusion of each work day.

6.16 ASSIGNMENT OF CONTRACT

A. The CONTRACTOR shall not assign, sublet, sell, transfer, or otherwise dispose of the Agreement or any portion thereof, or its right, title, or interested therein, or obligations thereunder, without the written consent of the OWNER except as imposed by law. If the CONTRACTOR violates this provision, the Agreement may be terminated at the option of the OWNER. In such event, the OWNER shall be relieved of all liability and obligations to the CONTRACTOR and to its assignee or transferee, growing out of such termination.

ARTICLE 7 - OTHER WORK

7.01 RELATED WORK

A. The OWNER may perform other work related to the Project at the site by the OWNER's own forces, have other work performed by utility owners, or let other direct contracts for the performance of the other work which may contain General Conditions similar to these. If the fact that such other work is to be performed was not noted in the Contact Documents, written notice thereof will be given to the CONTRACTOR prior to commencing any other work.

B. The CONTRACTOR shall afford each utility owner and other contractor who is a party to a direct contract (or the OWNER, if the OWNER is performing the additional work with the OWNER's employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of the other work. The CONTRACTOR shall properly connect and coordinate the WORK with the other work. The CONTRACTOR shall do all cutting, fitting, and patching of the WORK that may be required to make its several parts come together properly and integrate with the other work. The CONTRACTOR shall not endanger any work of others by cutting, excavating, or otherwise altering their work and shall only cut or alter their work with the written consent of the ENGINEER and the others whose work will be affected.

C. If the proper execution or results of any part of the CONTRACTOR's work depends upon the integration of work with the completion of other work by any other contractor or utility owner (or the OWNER), the CONTRACTOR shall inspect and report to the ENGINEER in writing all delays, defects, or deficiencies in the other work that renders it unavailable or unsuitable for proper integration with the CONTRACTOR's work. Except for the results or effects of latent or nonapparent defects and deficiencies in the other work, the CONTRACTOR's failure to report will constitute an acceptance of the other work as fit and proper for integration with the CONTRACTOR's work and as a waiver of any claim for additional time or compensation associated with the integration of the CONTRACTOR's work with the other work.

7.02 COORDINATION

A. If the OWNER contracts with others for the performance of other work on the Project at the site, a coordinator will be identified to the extent that the coordinator can be identified at this time, in the Supplementary General Conditions and delegated the authority and responsibility for coordination of the activities among the various contractors. The specific matters over which the coordinator has authority and the extent of the coordinator's authority and responsibility will be itemized in the Supplementary General Conditions or in a notice to the CONTRACTOR at such time as the identity of the coordinator is determined.

GENERAL CONDITIONS

ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.01 COMMUNICATIONS

A. The OWNER shall issue all its communications to the CONTRACTOR through the ENGINEER.

8.02 PAYMENTS

A. The OWNER shall make payments to the CONTRACTOR as provided in Paragraphs 14.05 and 14.09.

8.03 LANDS, EASEMENTS, AND SURVEYS

A. The OWNER's duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. The OWNER shall identify and make available to the CONTRACTOR copies of exploration reports and subsurface conditions tests at the site and in existing structures which have been utilized by the ENGINEER in preparing the Drawings and Technical Specifications as set forth in Paragraph 4.02

8.04 CHANGE ORDERS

A. The OWNER shall execute approved Change Orders for the conditions described in Paragraph 10.01D.

8.05 INSPECTIONS AND TESTS

A. The OWNER's responsibility with respect to inspection, tests, and approvals is set forth in Paragraph 13.03B.

8.06 SUSPENSION OF WORK

A. In connection with the OWNER's right to stop work or suspend work, see Paragraphs 13.04 and 15.01. Paragraphs 15.02 and 15.03 deal with the OWNER's right to terminate services of the CONTRACTOR under certain circumstances.

GENERAL CONDITIONS

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 OWNER'S REPRESENTATIVE

A. The ENGINEER will be the OWNER's representative during the construction period. The duties, responsibilities and the limitations of authority of the ENGINEER as the OWNER's representative during construction are set forth in a separate agreement with the OWNER and are summarized hereafter.

9.02 VISITS TO SITE

A. The ENGINEER will make visits to the site during construction to observe and inspect the progress and quality of the WORK and to determine, in general if the WORK is proceeding in accordance with the Contract Documents.

9.03 PROJECT REPRESENTATION

A. The ENGINEER will furnish a Project Representative to observe and inspect the performance of the WORK. The Project Representative and/or other authorized agents of the Engineer shall serve as the chief Owner/Engineer contact(s) with the Contractor during the construction phase. All submittals shall be delivered to and communications between the Engineer and the Contractor shall be handled by the Project Representative and/or other authorized agents. The Project Representative shall be the chief authorized representative of the Owner and the Engineer at the site of the work in all on-site relations with the Contractor.

9.04 CLARIFICATIONS AND INTERPRETATIONS

A. The ENGINEER will issue with reasonable promptness written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as the ENGINEER may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents.

9.05 AUTHORIZED VARIATIONS IN WORK

A. The ENGINEER may authorize minor variation in the WORK as described in the Contact Documents when such variations do not involve an adjustment in the Contract Price or the Contract Time and are consistent with the overall intent of the Contract Documents. These variations shall be accomplished by issuing a Field Order. The issuance of a Field Order requires the CONTRACTOR to perform the work described in the order promptly. If the

CONTRACTOR believes that a Field Order justifies an increase in the Contract Price or an extension of the Contract Time and parties are unable to agree as the amount or extent thereof, the CONTRACTOR may make a claim therefor as provided in Article 11 or 12.

9.06 REJECTION OF DEFECTIVE WORK

A. The ENGINEER is authorized to reject work which the ENGINEER believes to be defective and require special inspection or testing of the WORK as provided in Paragraph 13.03G, whether or not the WORK is fabricated, installed, or completed.

9.07 CONTRACTOR SUBMITTALS, CHANGE ORDERS, AND PAYMENTS

A. The ENGINEER will review for approval all Contractor submittals, including shop drawings, samples, substitutes, and "or equal" items, etc., in accordance with the procedures set forth in the Technical Specifications.

B. In connection with the ENGINEER's responsibilities as to Change Orders, see Articles 10, 11, and 12.

C. In connection with the ENGINEER's responsibilities with respect to Applications for Payment, see Article 14.

9.08 DECISIONS ON DISPUTES

A. All claims, disputes, and other matters concerning the acceptability of the WORK, the interpretation of the requirements of the Contract Documents pertaining to the performance of the WORK, and claims for changes in the Contract Price or Contract Time under Articles 11 and 12 will be referred to the ENGINEER in writing with a request for formal decision in accordance with this paragraph. The ENGINEER will render a decision in writing within 30 days of receipt of the request. Written notice of each claim, dispute, or other matter will be delivered by the CONTRACTOR to the ENGINEER promptly (but in no event later than 30 days) after the occurrence of the event. Written supporting data will be submitted to the ENGINEER with the written claim unless the ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim.

B. When reviewing the claim or dispute, the ENGINEER will not show partiality to the OWNER or the CONTRACTOR and will incur no liability in connection with any interpretation or decision rendered in good faith. The ENGINEER's rendering of a decision with respect to any claim, dispute, or other matter (except any which have been waived by the making or acceptance of final

payment as provided in Paragraph 14.12) shall be a condition precedent to the OWNER's or the CONTRACTOR's exercise of their rights or remedies under the Contract Documents or by Law or Regulations with respect to the claim, dispute, or other matter.

9.09 LIMITATION ON ENGINEER'S RESPONSIBILITIES

A. Neither the ENGINEER's authority to act pursuant to its agreement with the OWNER, nor the description of that authority under this Article 9, nor any other description of the ENGINEER's responsibility in the Contract Documents, nor any decision made by the ENGINEER in good faith either to exercise or not exercise its authority, shall give rise to any duty or responsibility on the part of the ENGINEER to the CONTRACTOR, any Subcontractor, any Supplier, any surety or any other person or organization performing any part of the WORK.

B. Whenever in the Contract Documents the terms "as ordered," "as directed," "as required," as allowed," "as reviewed," "as approved," or terms of like effect or import are used, or the adjectives "reasonable," "suitable," "acceptable," "proper," or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review, or judgement of the ENGINEER as to the WORK, it is intended that such requirement, direction, review, or judgment will be solely to evaluate the WORK for compliance with the Contract Documents, unless there is a specific statement indicating otherwise. The use of any such term or adjective shall not be effective to assign to the ENGINEER any duty or authority to supervise or direct the performance of the WORK or any duty or authority to undertake responsibility contrary to the provisions of its agreement with the OWNER.

C. The ENGINEER will not be responsible for the CONTRACTOR's means, methods, techniques, sequences, or procedures of construction not specified in the Contact Documents or the safety precautions and programs incident thereto.

D. The ENGINEER will not be responsible for the acts or omissions of the CONTRACTOR nor of any subcontractor, supplier, or any other person or organization performing any of the WORK to the extent that such acts or omissions are not reasonably discoverable considering the level of observation and inspection required by the ENGINEER's agreement with the OWNER.

GENERAL CONDITIONS

ARTICLE 10 - CHANGES IN THE WORK

10.01 GENERAL

A. Without invalidating the Agreement and without notice to any surety, the OWNER may at any time or from time to time, order additions, deletions, or revisions in the WORK; these will be authorized by a written Field Order and/or a Change Order issued by the ENGINEER. Upon receipt of any of these documents, the CONTRACTOR shall promptly proceed with the work involved pursuant to the applicable conditions of the Contract Documents.

B. If the OWNER and the CONTRACTOR are unable to agree upon the increase or decrease in the Contract Price or an extension or shortening of the Contract Time, if any, that should be allowed as a result of a Field Order, a claim may be made therefor as provided in Articles 11 or 12.

C. The CONTRACTOR shall not be entitled to an increase in the Contract Price nor an extension of the Contract Time with respect to any work performed that is not required by the Contact Documents as amended, modified, or supplemented by Change Order, except in the case of an emergency and except in the case of uncovering work provided in the Paragraph 13.03G.

D. The OWNER and the CONTRACTOR shall execute appropriate Change Orders covering:

1. Changes in the WORK which are ordered by the OWNER pursuant to Paragraph 10.01A;

2. Changes required because of acceptance of defective work under Paragraph 13.06;

3. Changes in the Contract Price or Contact Time which are agreed to by the parties; or

4. Any other changes agreed to by the parties.

E. If the provisions of any Bond require notice of any change to be given to a surety, the giving of these notices will be the CONTRACTOR's responsibility. The CONTRACTOR shall provide for the amount of each applicable Bond to be adjusted accordingly.

10.02 ALLOWABLE QUANTITY VARIATIONS

A. Whenever a unit price and quantity have been established for a bid item in the Contract Documents, the quantity stated may be increased or decreased to a maximum of 25 percent with no change in the unit price. An adjustment in the quantity in excess of 25 percent will be sufficient to justify a change in the unit price. Changes in the quantity of all bid items established in the Contract Documents, regardless of whether the changes are more or less than 25 percent and at the unit price established in the Contract Documents or adjusted otherwise, shall be documented by Change Orders.

B. In the event a part of the WORK is to be entirely eliminated and no lump sum or unit price is named in the Contract Documents to cover the eliminated work, the price of the eliminated work shall be agreed upon in writing by the OWNER and the CONTRACTOR. If the OWNER and the CONTRACTOR fail to agree upon the price of the eliminated work, the price shall be determined in accordance with the provisions of Article 11.

GENERAL CONDITIONS

ARTICLE 11 - CHANGE OF CONTRACT PRICE

11.01 GENERAL

A. The Contact Price constitutes the total compensation payable to the CONTRACTOR for performing the WORK. Except as directed by Change Orders, all duties, responsibilities, and obligations assigned to or undertaken by the CONTRACTOR shall be at its expense without change in the Contract Price.

B. The Contract Price may only be changed by a Change Order. Any claim for an increase in the Contact Price shall be based on written notice delivered by the CONTRACTOR to the ENGINEER promptly (but in no event later than 30 days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered with the claim, unless the ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim, and shall be accompanied by the CONTRACTOR's written statement that the amount claimed covers all known amounts (direct, indirect, and consequential) to which the CONTRACTOR is entitled as a result of the occurrence of the event. If the OWNER and the CONTRACTOR cannot otherwise agree on the amount involved, all claims for adjustment in the Contract Price shall be determined by the ENGINEER in accordance with Paragraph 9.08A. No claim for an adjustment in the Contact Price will be valid if not submitted in accordance with this Paragraph 11.01B.

C. The value of any work covered by a Change Order or of any claim for an increase or decrease in the Contact Price shall be determined in one of the following ways:

1. Where the work involved is covered by unit prices contained in the Contract Documents, by application of unit prices to the quantities of the items involved.

2. By mutual acceptance of a lump sum, which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.

3. On the basis of the cost of work (determined as provided in Paragraphs 11.02 and 11.03) plus a CONTRACTOR's fee for overhead and profit (determined as provided in Paragraph 11.04).

11.02 COST OF WORK (BASED ON TIME AND MATERIALS)

A. General: The term "cost of work" means the sum of all costs necessarily incurred and paid by the CONTRACTOR for labor, materials, and equipment in the proper performance of work. Except as otherwise may be agreed to in writing by the OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project.

B. Labor: The cost of labor used in performing work by the CONTRACTOR, a subcontractor, or other forces will be the sum of the following:

1. The actual wages paid plus any employer payments to, or on behalf of workers for fringe benefits including health and welfare, pension, vacation, and similar purposes. The cost of labor may include the rates paid to foremen when determined by the ENGINEER that the services of foremen do not constitute a part of the overhead allowance.

2. All payments imposed by state and federal laws including, but not limited to, compensation insurance, and social security payments.

3. The amount paid for subsistence and travel required by collective bargaining agreements, or in accordance with the regular practice of the employer.

At the beginning of the extra work and as later requested by the ENGINEER, the CONTRACTOR shall furnish the ENGINEER proof of labor compensation rates being paid.

C. Materials: The cost of materials used in performing work will be the cost to the purchaser, whether CONTRACTOR or subcontractor, from the supplier thereof, except as the following are applicable:

1. Trade discounts available to the purchase shall be credited to the OWNER notwithstanding the fact that such discounts may not have been taken by the CONTRACTOR.

2. For materials secured by other than a direct purchase and direct billing to the purchaser, the cost shall be deemed to be the price paid to the actual supplier as determined by the ENGINEER. Markup except for actual costs incurred in the handling of such materials will not be allowed.

3. Payment for materials from sources owned wholly or in part by the purchaser shall not exceed the price paid by the purchaser for similar materials from these sources on extra work items or current wholesale price for the materials delivered to the work site, whichever is lower.

4. If in the opinion of the ENGINEER the cost of material is excessive, or the CONTRACTOR does not furnish satisfactory evidence of the cost of the material, then the cost shall be deemed to be the lowest current wholesale price for the quantity concerned, delivered to the work site less trade discount. The OWNER reserves the right to furnish materials for the extra work and no claim shall be made by the CONTRACTOR for costs and profit on such materials.

D. Equipment: The CONTRACTOR will be paid for the use of equipment at the rental rate listed for the equipment specified in the Supplementary General Conditions. The rental rate will be used to compute payments for equipment whether the equipment is under the CONTRACTOR's control through direct ownership, leasing, renting, or another method of acquisition. The rental rate to be applied for use of each item of equipment shall be the rate resulting in the least total cost to the Owner for the total period of use. If it is deemed necessary by the CONTRACTOR to use equipment not listed in the Supplementary General Conditions an equitable rental rate for the equipment will be established by the ENGINEER. The CONTRACTOR may furnish cost data which might assist the ENGINEER in the establishing the rental rate.

1. All equipment shall, in the opinion of the ENGINEER, be in good working condition and suitable for the purpose for which the equipment is to be used.

2. Before construction equipment is used on the extra work, the CONTRACTOR shall plainly stencil or stamp an identifying number thereon at a conspicuous location, and shall furnish to the ENGINEER, in duplicate, a description of the equipment and its identifying number.

3. Unless otherwise specified, manufacturers' ratings and manufacturer approved modifications shall be used to classify equipment for the determination of applicable rental rates. Equipment which has no direct power unit shall be powered by a unit of at least the minimum rating recommended by the manufacturer.

4. Individual pieces of equipment or tools having a replacement value of $100 or less, whether or not consumed by use, shall be considered to be small tools and no payment will be made therefore.

5. Rental time will not be allowed while equipment is inoperative due to breakdowns.

E. Equipment on the Work: The rental time to be paid for equipment used on the WORK shall be the time the equipment is in productive operation on the extra work being performed and, in addition, shall include the time required to move the equipment to the location of the extra work and return it to the original location or to another location that requires no more moving time than that required to return it to its original location. Moving time will not be paid if the equipment is used on other than the extra work, even though located at the site of the extra work. Loading and transporting costs will be allowed, in lieu of moving time, when the equipment is moved by means other than its own power. However, no payment will be made for loading and transporting costs when the equipment is used on other than the extra work even though located at the site of the extra work. The following shall be used in computing the rental time of equipment on the WORK.

1. When hourly rates are listed, any part of an hour less than 30 minutes of operation shall be considered to be 1/2-hour of operation, and any part of an hour in excess of 30 minutes will be considered one hour of operation.

2. When daily rates are listed, any part of a day less than 4 hours operation shall be considered to be 1/2-day of operation. When owner-operated equipment is used to perform extra work to be paid for on a time and materials basis, the CONTRACTOR will be paid for the equipment and operator, as set forth in Paragraph (3), (4), and (5), following.

3. Payment for the equipment will be made in accordance with the provisions in Paragraph 11.02D, herein.

4. Payment for the cost of labor and subsistence or travel allowance will be made at the rates paid by the CONTRACTOR to other workers operating similar equipment already on the WORK, or in the absence of such labor, established by collective bargaining agreements for the type of workmen and location of the extra work, whether or not the operator is actually covered by such an agreement. A labor surcharge will be added to the cost of labor described herein in accordance with the provisions of Paragraph 11.02B, herein, which surcharge shall constitute full compensation for payments imposed by state and federal laws and all payments made to on behalf of workers other than actual wages.

5. To the direct cost of equipment rental and labor, computed as provided herein, will be added the allowances for equipment rental and labor as provided in Paragraph 11.04, herein.

11.03 SPECIAL SERVICES

A. Special work or services are defined as that work characterized by extraordinary complexity, sophistication, or innovation or a combination of the foregoing attributes which are unique to the construction industry. The following may be considered by the ENGINEER in making estimates for payment for special services:

1. When the ENGINEER and the CONTRACTOR, by agreement, determine that a special service or work is required which cannot be performed by the forces of the CONTRACTOR or those of any of its subcontractors, the special service or work may be performed by an entity especially skilled in the work to be performed. After validation of invoices and termination of market values by the ENGINEER, invoices for special services or work based upon the current fair market value thereof may be accepted without complete itemization of labor, material, and equipment rental cost.

2. When the CONTRACTOR is required to perform work necessitating special fabrication or machining process in a fabrication or a machine shop facility away from the job site, the charges for that portion of the work performed at the off-site facility may by agreement, be accepted as a special service and accordingly, the invoices from the work may be accepted without detailed itemization.

3. All invoices for special services will be adjusted by deducting all trade discounts offered or available, whether the discounts were taken or not. In lieu of the allowances for overhead and profit specified in Paragraph 11.04, herein, an allowance of 5 percent will be added to invoices for special services.

B. All work performed hereunder shall be subject to all of the provisions of the Contract Documents and the CONTRACTOR's sureties shall be bound with reference hereto as under the original Agreement. Copies of all amendments to surety bonds or supplemental surety bonds shall be submitted to the OWNER for review prior to the performance of any work hereunder.

11.04 CONTRACTOR'S FEE

A. WORK ordered on the basis of time and materials will be paid for at the actual necessary cost as determined by the ENGINEER, plus allowances for overhead and profit. For extra work involving a combination of increases and decreases in the WORK the actual necessary cost will be the arithmetic sum of the additive and deductive costs. The allowance for overhead and profit shall include full compensation for superintendence, bond and insurance premiums, taxes, office expenses, and all other items of expense or cost not included in the cost of labor, materials, or equipment provided for under Paragraphs 11.02B, C, and D, herein including extended overhead and home office overhead. The allowance for overhead and profit will be made in accordance with the following schedule:

ACTUAL NECESSARY COST OVERHEAD AND PROFIT ALLOWANCE

Labor ..... 10 percent

Materials ..... 10 percent

Equipment ..... 10 percent

B. It is understood that labor, materials, and equipment may be furnished by the CONTRACTOR or by the subcontractor, the allowance specified herein shall be applied to the labor, materials, and equipment costs of the subcontractor, to which the CONTRACTOR may add 5 percent of the subcontractor's total cost for the extra work. Regardless of the number of hierarchical tiers of subcontractors, the 5 percent increase above the subcontractor's total cost which includes the allowances for overhead and profit specified herein may be applied one time only for each separate work transaction.

GENERAL CONDITIONS

ARTICLE 12 - CHANGE OF CONTRACT TIME

12.01 GENERAL

A. The Contract Time may only be changed by a Change Order. Any claim for an extension of the Contract time shall be based on written notice delivered by the CONTRACTOR to the ENGINEER promptly (but in no event later than 30 days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within 30 days after such occurrence (unless the ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the CONTRACTOR's written statement that the adjustment claimed is the entire adjustment to which the CONTRACTOR has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Time shall be determined by the ENGINEER in accordance with Paragraph 9.08 if the OWNER and the CONTRACTOR cannot otherwise agree. No claim for an adjustment in the Contract Time will be valid if not submitted in accordance with the requirements of this Paragraph 12.01A.

B. The Contract Time will be extended in an amount equal to time lost if the CONTRACTOR makes a claim as provided in Paragraph 12.01A and the ENGINEER determines that the delay was caused by events beyond the control of the CONTRACTOR. Examples of events beyond the control of the CONTRACTOR include acts or neglect by the OWNER or others performing additional work as contemplated by Article 7, or by acts of God or of the public enemy, fire, floods, epidemics, quarantine restrictions, strikes, labor disputes, sabotage, or freight embargoes.

C. All time limits stated in the Contract Documents are of the essence.

D. None of the aforesaid time extensions shall entitle the CONTRACTOR to any adjustment in the Contract Price or any damages for delay. Furthermore, the CONTRACTOR hereby indemnifies and holds harmless the OWNER and ENGINEER, their officers, agents and employees from and against all claims, damages, losses and expenses (including lost property and attorney's fees) arising out of or resulting from the temporary suspension of work whether for the OWNER's convenience as defined in Article 15.01 (a) or for whatever other reasons including the stoppage of work by the ENGINEER for the CONTRACTOR's failure to comply with any order issued by the ENGINEER.

12.02 EXTENSIONS OF THE TIME FOR DELAY DUE TO INCLEMENT WEATHER

A. "Inclement weather" is any weather condition or conditions resulting immediately therefrom, causing the CONTRACTOR to suspend construction operations or preventing the CONTRACTOR from proceeding with at least 75 percent of the normal labor and equipment force engaged on the WORK.

B. Should the CONTRACTOR prepare to begin work at the regular starting time at the beginning of any regular work shift on any day on which inclement weather, or its effects on the condition of the WORK prevents work from beginning at the usual starting time and the crew is dismissed as a result thereof, the CONTRACTOR will not be charged for a working day whether or not conditions change thereafter during the day and the major portion of the day could be considered to be suitable for construction operations.

C. The CONTRACTOR shall base its construction schedule upon the inclusion of the number of days of inclement weather specified in the paragraph entitled "Inclement weather delays" of the Supplementary General Conditions. No extension of the Contract Time due to inclement weather will be considered until after the stated number of days of inclement weather has been reached. However, no reduction in Contract Time will be made if the number of inclement weather days is not reached.

12.03 EXTENSIONS OF TIME FOR OTHER DELAYS

A. If the CONTRACTOR is delayed in completion of the WORK beyond the time named in the Contract Documents for the completion of the WORK, by acts of God or of the public enemy, fire, floods, epidemics, quarantine restrictions, strikes, labor disputes, industry-wide shortage of raw materials, sabotage or freight embargoes, the CONTRACTOR shall be entitled to an adjustment in the Contract Time. No such adjustment will be made unless the CONTRACTOR shall notify the ENGINEER in writing of the causes of delay within 15 calendar days from the beginning of any such delay. The ENGINEER shall ascertain the facts and the extent of the delay. No adjustment in time shall be made for delays resulting from noncompliance with the Contract, accidents, failure on the part of the CONTRACTOR to carry out the provisions of the Contract including failure to provide materials, equipment or workmanship meeting the requirements of the Contract Documents; the occurrence of such events shall not relieve the CONTRACTOR from the necessity of maintaining the required progress.

B. In the event that Contract completion is delayed beyond the Contract Time named in the Specifications by reason of shortages of raw materials required for CONTRACTOR-furnished items, the CONTRACTOR shall be entitled to

an adjustment in the Contract Time in like manner as if the WORK had been suspended for the convenience and benefit of the OWNER; provided, however, that the CONTRACTOR shall furnish documentation acceptable to the OWNER and ENGINEER that he placed or attempted to place firm orders with suppliers at a reasonable time in advance of the required date of delivery of the items in question, that such shortages shall have developed following the date such orders were placed or attempts made to place same, that said shortages are general throughout the affected industry, that said shortages are shortages of raw materials required to manufacture CONTRACTOR-furnished items and not simply failure of CONTRACTOR's suppliers to manufacture, assemble or ship items on time, and that the CONTRACTOR shall, to the degree possible, have made revisions in the sequence of his operations, within the terms of the Contract, to offset the expected delay. The CONTRACTOR shall notify the ENGINEER, in writing, concerning the cause of delay, within 15 calendar days of the beginning of such delay. The validity of any claim by the CONTRACTOR to an adjustment in the Contract Time shall be determined by the OWNER acting through the ENGINEER, and his findings thereon shall be based on the ENGINEER's knowledge and observations of the events involved and documentation submitted by the CONTRACTOR, showing all applicable facts relative to the foregoing provisions. Only the physical shortage of raw materials will be considered under these provisions as a cause for adjustment of time and no consideration will be given to any claim that items could not be obtained at a reasonable, practical, or economical cost or price, unless it is shown to the satisfaction of the OWNER that such items could have been obtained only at exorbitant prices entirely out of line with current rates taking into account the quantities involved and the usual practices in obtaining such quantities.

C. If the CONTRACTOR is delayed in completion of the WORK by reason of changes made under the provisions of Article 10 or changed conditions as provided under Article 4.03, or by failure of the OWNER to acquire or clear right-of-way as provided under Article 15.01, or by any act of the ENGINEER or of the OWNER, not contemplated by the Contract, an adjustment in the Contract time will be made by the OWNER in like manner as if the WORK had been suspended for the convenience and benefit of the OWNER, except, that if the WORK is increased as a result of changes, the OWNER, at his sole discretion, may grant an adjustment in the number of calendar days for completion of the Contract. In the event of such delay, the CONTRACTOR shall notify the ENGINEER in writing of the causes of delay within 15 calendar days from the beginning of any such delay.

GENERAL CONDITIONS

ARTICLE 13 - WARRANTY AND GUARANTEE; TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

13.01 WARRANTY, GUARANTEE AND MAINTENANCE PERIOD

A. The CONTRACTOR warrants and guarantees to the OWNER and the ENGINEER that all work, equipment, materials and workmanship are in accordance with the Contract Documents and are not defective. Prompt notice of defects discovered by the OWNER or ENGINEER shall be given to the CONTRACTOR. All defective work, whether or not in place, may be rejected, corrected, or accepted as provided in this Article 13.

B. If within one (1) year after the date of Final Completion, as set by the Engineer's Notice of Completion, or a longer period of time prescribed by Laws or Regulations or by the terms of any applicable special guarantee or specific provisions of the Contract Documents, any work is found to be defective, the OWNER shall notify the CONTRACTOR in writing and the CONTRACTOR shall promptly, without cost to the OWNER and in accordance with the OWNER's written notification, either correct the defective work, or, if it has been rejected by the OWNER, remove it from the site and replace it with non-defective work. In the event the CONTRACTOR does not promptly comply with the notification, or in an emergency where delay would cause serious risk of loss or damage, the OWNER may have the defective work corrected or rejected work removed and replaced. All direct, indirect, and consequential costs of the removal and replacement including but not limited to fees and charges of engineers, architects, attorneys and other professionals will be paid by the CONTRACTOR. This paragraph shall not be construed to limit nor diminish the CONTRACTOR's absolute guarantee to complete the WORK in accordance with the Contract Documents.

13.02 ACCESS TO WORK

A. The ENGINEER, other representatives of the OWNER, testing agencies, and governmental agencies with jurisdictional interests shall have access to the work at reasonable times for their observation, inspections, and testing. The CONTRACTOR shall provide proper and safe conditions for their access.

13.03 TESTS AND INSPECTIONS

A. The CONTRACTOR shall give the ENGINEER timely notice of readiness of the WORK for all required inspections, tests, or approvals.

B. If Laws or Regulations of any public body other than the OWNER, with jurisdiction over the WORK require any work to be specifically inspected, tested, or approved, the CONTRACTOR shall pay all costs in connection therewith. The CONTRACTOR shall also be responsible for and shall pay all costs in connection with any inspection or testing required in connection with the OWNER's or the ENGINEER's acceptance of a Supplier of materials or equipment proposed as a substitution or-equal to be incorporated in the WORK and of materials or equipment submitted for review prior to the CONTRACTOR's purchase for incorporation in the WORK. The cost of all inspections, tests, and approvals with the exception of the above which are required by the Contract Documents shall be paid by the OWNER (unless otherwise specified).

C. The ENGINEER will make, or have made, such inspections and test as the ENGINEER deems necessary to see that the WORK is being accomplished in accordance with the requirements of the Contract Documents. The Contractor without additional cost to the OWNER, shall provide the labor and equipment necessary to make the WORK available for inspections. Unless otherwise specified in the Supplementary General Conditions or the OWNER-ENGINEER Agreement, all other costs of inspection and testing will be borne by the OWNER. In the event the inspections or tests reveal non-compliance with the requirements of the Contract Documents, the CONTRACTOR shall bear the cost of corrective measures deemed necessary by the ENGINEER, as well as the cost of subsequent re-inspection and retesting. Neither observations by the ENGINEER nor inspections, tests, or approvals by others shall relieve the CONTRACTOR from the CONTRACTOR's obligation to perform the WORK in accordance with the Contract Documents.

D. All inspections, tests, or approvals other than those required by Laws or Regulations of any public body having jurisdiction shall be performed by properly licensed organizations selected by the OWNER.

E. If any work (including the work of others) that is to be inspected, tested, or approved is covered without the ENGINEER's written authorization, it must, if requested by the ENGINEER, be uncovered for testing, inspection, and observation. The uncovering shall be at the CONTRACTOR's expense unless the CONTRACTOR timely notified the ENGINEER of the CONTRACTOR's intention to cover the same and the ENGINEER failed to act with reasonable promptness in response to the notice.

F. In any work is covered contrary to the written request of the ENGINEER, it must, if requested by the ENGINEER, be uncovered for the ENGINEER's observation and replaced at the CONTRACTOR's expense.

G. If the ENGINEER considers it necessary or advisable that covered work be observed, inspected or tested by the ENGINEER or others, the ENGINEER shall direct the CONTRACTOR to uncover, expose, or otherwise make available for observation, inspection, or testing that portion of the work in question. The CONTRACTOR shall comply with the ENGINEER's direction and furnish all necessary labor, material, and equipment. If found the work is defective, the CONTRACTOR shall bear all direct, indirect and consequential costs of uncovering, exposure, observation, inspection, and testing and of satisfactory reconstruction of the work, including but not limited to fees and charges for engineers, architects, attorneys, and other professionals. However, if the work is not defective, the CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both. The increase in Contract Time and Contract Price shall be the CONTRACTOR's actual time and costs directly attributable to uncovering and exposing the work. If the parties are unable to agree as to the amount or extent of the changes, the CONTRACTOR may make a claim therefor as provided in Articles 11 and 12.

13.04 OWNER MAY STOP THE WORK

A. If the WORK is defective, or the CONTRACTOR fails to perform work in such a way that the completed WORK will conform to the Contract Documents, the OWNER may order the CONTRACTOR to stop the WORK, or any portion thereof, until the cause for the order has been eliminated. This right of the OWNER to stop the WORK shall not give rise to any duty on the part of the OWNER to exercise this right for the benefit of the CONTRACTOR or any other party.

13.05 CORRECTION OR REMOVAL OF DEFECTIVE WORK

A. When directed by the ENGINEER, the CONTRACTOR shall promptly correct all defective work, whether or not fabricated, installed, or completed, or, if the

work has been rejected by the ENGINEER, remove it from the site and replace it with non-defective work. The CONTRACTOR shall bear all direct, indirect and consequential costs of correction or removal, including but not limited to fees and charges of engineers, architects, attorneys, and other professionals made necessary thereby.

13.06 ACCEPTANCE OF DEFECTIVE WORK

A. If, instead of requiring correction or removal and replacement of defective work, the OWNER prefers to accept the work, the OWNER may do so. The CONTRACTOR shall bear all direct, indirect, and consequential costs attributable to the OWNER's evaluation of and determination to accept the defective work. If any acceptance of defective work occurs prior to final payment, a Change Order will be issued incorporating the necessary revisions in the Contact Documents with respect to the WORK, and the OWNER shall be entitled to an appropriate decrease in the Contract Price.

GENERAL CONDITIONS

ARTICLE 14 - PAYMENTS TO CONTRACTOR, LIQUIDATED DAMAGES AND COMPLETION

14.01 SCHEDULE OF VALUES (LUMP SUM PRICE BREAKDOWN)

A. The schedule of values or lump sum price breakdown established as provided in the Technical Specifications shall serve as the basis for progress payments and will be incorporated into the form of Application for Payment included in the Contract Documents.

14.02 UNIT PRICE BID SCHEDULE

A. Progress payments for unit price work will be based on the number of units completed.

14.03 APPLICATION FOR PROGRESS PAYMENT

A. Unless otherwise prescribed by the Owner, on the 25th of each month, the CONTRACTOR shall submit to the ENGINEER for review and approval, an Application for Payment completed and signed by the CONTRACTOR covering the WORK completed as of the date of the Application and accompanied by such supporting documentation as required by the Contract Documents.

B. The Application for Payment shall identify, as a sub-total, the amount of the CONTRACTOR's Total Earnings to Date, plus the Value of Materials at the Site which have not yet been incorporated in the WORK, and less a deductive adjustment for materials installed which were not previously incorporated in the WORK, but for which payment was allowed under the provisions of payment for Materials Stored at the Site but not yet incorporated in the WORK.

C. The Net Payment Due to the CONTRACTOR shall be the above-mentioned sub-total, from which shall be deducted the retainage amount and the total amount of all previous payments made to the CONTRACTOR.

D. The OWNER may withhold and retain 5% of each approved progress payment to the CONTRACTOR. The total retention proceeds withheld shall not exceed 5% of the total construction price. All retention proceeds shall be placed by the OWNER in an interest-bearing account. The interest accrued shall be for the benefit of the CONTRACTOR and its subcontractors, and it shall be paid after the WORK has been completed and accepted by the OWNER. CONTRACTOR shall ensure that any interest accrued on the

retainage is distributed by the CONTRACTOR to its subcontractors on a pro rata basis.

E. Any retention proceeds withheld, and any accrued interest, shall be released by the OWNER pursuant to an Application for Payment from the CONTRACTOR within 45 days from the later of:

1. the date the OWNER receives the final Application for Payment from the CONTRACTOR;

2. the date that a certificate of occupancy or final acceptance notice is issued to:

   (a) the Contractor who obtained the building permit from the building inspector or from a public agency;

   (b) the OWNER; or

   (c) the ENGINEER.

3. the date the CONTRACTOR accepts final payment for the Work; or

4. the date that a public agency or building inspector having authority to issue its own certificate of occupancy does not issue the certificate but permits partial or complete occupancy of a newly constructed or remodeled building; provided, however, that if only partial occupancy of a building is permitted, any retention proceeds withheld and retained, and any accrued interest, shall be partially released in direct proportion to the value of the part of the building occupied.

Each Application for Payment from the CONTRACTOR shall include documentation of lien releases or waivers.

F. Notwithstanding any other provision in this Article to the contrary,

1. If the CONTRACTOR is in default or breach of the terms and conditions of the Contract Documents, the OWNER may withhold from payment to the CONTRACTOR for so long as reasonably necessary an amount necessary to cure the breach or default of the CONTRACTOR; or

2. If the WORK or a portion of the WORK has been substantially completed, the OWNER may retain until completion up to twice the

fair market value of the WORK of the CONTRACTOR that has not been completed:

(a) in accordance with the Contract Documents; or

(b) in the absence of applicable provisions in the Contract Documents to generally accepted craft standards.

3. If the OWNER refuses payment under subparagraphs (F)(i) or (ii), it shall describe in writing within 45 days of withholding such amounts what portion of the WORK was not completed according to the standards specified in the Contract Documents.

G. The CONTRACTOR shall distribute retention proceeds as outlined below:

1. Except as provided in Paragraph 14.03.G.2, below, if the CONTRACTOR receives retention proceeds, it shall pay each of its subcontractors from whom retention has been withheld each subcontractor's share of the retention received within ten days from the day that all or any portion of the retention proceeds is received from the OWNER.

2. Notwithstanding Paragraph 14.03.G.1, above, if a retention payment received by the CONTRACTOR is specifically designated for a particular subcontractor, payment of the retention shall be made to the designated subcontractor.

H. Except as otherwise provided in the Supplementary General Conditions, the value of materials stored at the site shall be valued at 95 percent of the value of the materials. This amount shall be based upon the value of all acceptable materials and equipment stored at the site or at another location agreed to in writing by the OWNER; provided, each individual item has a value of more than $5,000 and will become a permanent part of the WORK. The Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that the CONTRACTOR has received the materials and equipment free and clear of all liens, charges, security interests, and encumbrances (which are hereinafter in these General Conditions referred to as "Liens") and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect the OWNER's interest therein, all of which will be satisfactory to the OWNER.

14.04 CONTRACTOR'S WARRANTY OF TITLE

A. The CONTRACTOR warrants and guarantees that title to all work, materials, and equipment covered by an Application for Payment, whether incorporated in the WORK or not, will pass to the OWNER no later than the time of final payment free and clear of all liens.

14.05 REVIEW OF APPLICATIONS FOR PROGRESS PAYMENT

A. The ENGINEER will, within 7 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to the OWNER, or return the Application to the CONTRACTOR indicating in writing the ENGINEER's reasons for refusing to recommend payment. In the later case, the CONTRACTOR may make the necessary corrections and resubmit the Application. Thirty days after presentation of the Application for Payment with the ENGINEER's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.05B) become due and when due will be paid by the OWNER to the CONTRACTOR.

B. The OWNER may refuse to make payment of the full amount recommended by the ENGINEER to compensate for claims made by the OWNER on account of the CONTRACTOR's performance of the WORK or other items entitling the OWNER to a credit against the amount recommended, but the OWNER must give the CONTRACTOR written notice within 7 days (with a copy to the ENGINEER) stating the reasons for such action.

14.06 PARTIAL UTILIZATION

A. The OWNER may utilize or place into service any item of equipment or other usable portion of the WORK at any time prior to completion of the WORK. The OWNER shall notify the CONTRACTOR in writing of its intent to exercise this right. The notice will identify the equipment or specific portion or portions of the WORK to be utilized or otherwise placed into service.

B. It shall be understood by the CONTRACTOR that until such written notification is issued, all responsibility for care and maintenance of all items or portions of the WORK to be partially utilized shall be borne by the CONTRACTOR. Upon the issuance of a notice of partial utilization, the ENGINEER will deliver to the OWNER and the CONTRACTOR a written recommendation as to division of responsibilities between the OWNER and the CONTRACTOR with respect to security, operation, safety, maintenance,

heat, utilities and insurance. Upon the OWNER's acceptance of these recommendations, the ENGINEER's aforesaid recommendation will be binding on the OWNER and the CONTRACTOR until final payment.

C. The CONTRACTOR shall retain full responsibility for satisfactory completion of the WORK, regardless of whether a portion thereof has been partially utilized by the OWNER and the CONTRACTOR's one year correction period shall commence only after the date of Final Completion for the WORK.

14.07 LIQUIDATED DAMAGES

A. The CONTRACTOR shall pay to the OWNER the amount specified in the Supplemental General Conditions, not as a penalty but as liquidated damages, if he fails to complete the WORK or specified parts of the WORK within the time or times agreed upon. The periods for which these damages shall be paid shall be the number of Days from the agreed date or Contract Time as contained in the Agreement, or from the date of termination of any extension of time approved by the OWNER, to the date or dates on which the ENGINEER certifies Substantial Completion of WORK or specified parts of the WORK as provided in Article 14.08, herein. The OWNER may deduct the amount of said damages from any monies due or to become due the CONTRACTOR. After Substantial Completion, if the CONTRACTOR fails to complete the remaining WORK within 45 days or any proper extension thereof granted by OWNER, CONTRACTOR shall pay OWNER the amount stated in the Supplemental General Conditions as liquidated damages for each day that expires after the 45 days until readiness for final payment.

B. The said amount is fixed and agreed upon by and between the CONTRACTOR and the OWNER because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the OWNER would sustain; and said amount is agreed to be the amount of damages which the OWNER would sustain. Said damages are not in lieu of but in addition to other actual or consequential damages to which the OWNER may be entitled.

C. All times specified in the Contract Documents are hereby declared to be of the essence.

14.08 SUBSTANTIAL COMPLETION

A. When the CONTRACTOR considers the WORK ready for its intended use, and the CONTRACTOR has delivered to the ENGINEER all maintenance and operating instructions, schedules, guarantees, bonds, certificates of

inspection, marked-up record documents and other documents, all as required by the Contract Documents, the CONTRACTOR may notify the OWNER and the ENGINEER in writing that the WORK is substantially complete and request that the ENGINEER prepare a Certificate of Substantial Completion. Within a reasonable time thereafter, the OWNER, the CONTRACTOR, and the ENGINEER shall make an inspection of the WORK to determine the status of completion. If the ENGINEER does not consider the WORK substantially complete, the ENGINEER will notify the OWNER and CONTRACTOR in writing giving the reasons therefor. If the ENGINEER considers the WORK substantially complete, the ENGINEER will prepare and deliver to the OWNER for its execution the Certificate of Substantial Completion signed by the ENGINEER and CONTRACTOR, which shall fix the date of Substantial Completion.

B. The Certificate of Substantial Completion shall be a release by the CONTRACTOR of the OWNER and its agents from all claims and liability to the CONTRACTOR for anything done or furnished for, or relating to, the WORK or for any act or neglect of the OWNER or of any person relating to or affecting the WORK, to the date of Substantial Completion, except demands against the OWNER for the remainder of the amounts kept or retained from progress payments and excepting pending, unresolved claims filed in writing prior to the date of Substantial Completion. At the time of delivery of the Certificate of Substantial Completion, the ENGINEER will deliver to the OWNER and the CONTRACTOR, if applicable, a written recommendation as to division of responsibilities between the OWNER and the CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities and insurance. Upon the OWNER's acceptance of these recommendations, the ENGINEER's recommendation will be binding on the OWNER and the CONTRACTOR until final payment.

C. The OWNER, upon written notice to the CONTRACTOR, shall have the right to exclude the CONTRACTOR from the WORK after the date of Substantial Completion, and complete all or portions of the WORK at the CONTRACTOR's expense.

14.09 COMPLETION AND FINAL PAYMENT

A. Upon written certification from the CONTRACTOR that the WORK is complete (if a Certificate of Substantial Completion has been issued this certification must occur within 45 days of that date), the ENGINEER will make a final inspection with the OWNER and the CONTRACTOR. If the OWNER and ENGINEER do not consider the WORK complete, the ENGINEER will notify the OWNER and the CONTRACTOR in writing of all particulars in which this inspection reveals that the WORK is incomplete or defective. The CONTRACTOR shall immediately take the measures necessary to remedy these deficiencies. If the ENGINEER and OWNER consider the WORK complete, the CONTRACTOR may proceed to file its application for final payment pursuant to this Article. At the request of the CONTRACTOR, the ENGINEER may recommend to the OWNER that certain minor deficiencies in the WORK that do not prevent the entire WORK from being used by the OWNER for its intended use, and the completion of which will be unavoidably delayed due to no fault of the CONTRACTOR, be exempted from being completed prerequisite to final payment. These outstanding items of pickup work, or "punch list items", shall be listed on the ENGINEER's Notice of Completion, together with the recommended time limits for their completion, and extended warranty requirements for those items and the value of such items.

B. After the issuance of the Notice of Completion and after the CONTRACTOR has completed corrections that have not been exempted to the satisfaction of the ENGINEER and delivered to the ENGINEER all required additions and modifications to maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, marked-up record documents and other documents, all as required by the Contract Documents; and after the ENGINEER has indicated that the WORK is acceptable, the CONTRACTOR may make application for final payment following the procedure for progress payments. The final application for payment shall be accompanied by all documentation called for in the Contract Documents and other data and schedules as the OWNER or ENGINEER may reasonably require, including an affidavit of the CONTRACTOR that all labor, services, material, equipment and other indebtedness connected with the WORK for which the OWNER or his property might in any way be responsible, have been paid or otherwise satisfied, and a consent of the payment bond surety to final payment, all in forms approved by the OWNER.

14.10 FINAL APPLICATION FOR PAYMENT

A. If, on the basis of the ENGINEER's observation of the WORK during construction and final inspection, and the ENGINEER's review of the final application for payment and accompanying documentation, all as required by the Contract Documents, the ENGINEER is satisfied that the WORK has been completed and the CONTRACTOR has fulfilled all of his obligations under the Contract Documents, the ENGINEER will, within ten days after receipt of the final application for payment, indicate in writing his recommendation of payment and present the application to the OWNER for payment. Thereupon, the ENGINEER will give written notice to the OWNER and the CONTRACTOR that the WORK is acceptable by executing the ENGINEER's Notice of Completion. Otherwise, the ENGINEER will return the application to the CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case the CONTRACTOR shall make the necessary corrections and resubmit the application.

B. Within 45 calendar days after the ENGINEER's filing of the Notice of Completion, the OWNER will make final payment including all deducted retainage (except as noted below) to the CONTRACTOR. The OWNER's remittance of final payment shall be the OWNER's acceptance of the WORK if formal acceptance of the WORK is not indicated otherwise. The final payment shall be that amount remaining after deducting all prior payments and all amounts to be kept or retained under the provisions of the Contract, including the following items:

1. Liquidated damages, as applicable.

2. All amounts retained by the OWNER under Paragraph 14.03(F).

14.11 CONTRACTOR'S CONTINUING OBLIGATIONS

A. The CONTRACTOR's obligation to perform and complete the WORK in accordance with the Contract Documents shall be absolute. Neither recommendation of any progress or final payment by the ENGINEER, nor the issuance of a Certificate of Substantial Completion or Notice of Completion, nor payment by the OWNER to the CONTRACTOR under the Contract Documents, nor any use or occupancy of the WORK or any part thereof by the OWNER, nor any act of acceptance by the OWNER nor any failure to do so, nor any review of a shop drawing or sample submittal, will constitute an acceptance of work or materials not in accordance with the Contract Documents or a release of the CONTRACTOR's obligation to perform the WORK in accordance with the Contract Documents.

14.12 FINAL PAYMENT TERMINATES LIABILITY OF OWNER

A. Final payment is defined as the last progress payment made to the CONTRACTOR for earned funds, less deductions listed in Paragraph 14.10B herein. The acceptance by the CONTRACTOR of the final payment referred to in Paragraph 14.10 herein, shall be a release of the OWNER and its agents from all claims of liability to the CONTRACTOR for anything done or furnished for, or relating to, the work or for any act or neglect of the OWNER or of any person relating to or affecting the work, except demands against the OWNER for the remainder, if any, of the amounts kept or retained under the provisions of Paragraph 14.10 herein; and excepting pending, unresolved claims filed prior to the date of the Certificate of Substantial Completion.

GENERAL CONDITIONS

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 SUSPENSION OF WORK BY OWNER

A. The OWNER acting through the ENGINEER may, by written notice to the Contractor, temporarily suspend the WORK, in whole or in part, for a period or periods of time, but not to exceed 90 days, for the convenience and benefit of the OWNER upon the occurrence of any one or more of the following: (1) unsuitable weather; (2) delay in delivery of OWNER- furnished equipment or materials, or such other conditions as are considered unfavorable for prosecution of the work; (3) Shortfall in construction funds; (4) Constraints imposed by public entities, public utilities, property owners or legal proceedings; (5) Failure or delay in acquisition of easements or right-of-way by the OWNER; or (6) Other conditions which, in the opinion of the OWNER, warrant a delay in the WORK. Suspended WORK shall be resumed by the CONTRACTOR within 10 calendar days of receipt from the ENGINEER of written notice to proceed. Whenever the OWNER temporarily suspends work for any conditions enumerated in this Article 15.01 A, the CONTRACTOR shall be entitled to an adjustment in the Contract Time as specified in Article 12.03 C.

B. The suspension of work shall be effective upon receipt by the Contractor of the written order suspending the work and shall be terminated upon receipt by the Contractor of the written order terminating the suspension.

C. The CONTRACTOR hereby indemnifies and holds harmless the OWNER and ENGINEER, their officers, agents and employees, from and against all claims, damages, losses and expenses, including lost profits and attorney's fees, arising out of or resulting from the temporary suspension of the WORK, whether for the OWNER's convenience described in this Article or for whatever other reasons, including the stoppage of work by the ENGINEER for the CONTRACTOR's failure to comply with any order issued by the ENGINEER.

15.02 TERMINATION OF AGREEMENT BY OWNER (CONTRACTOR DEFAULT)

A. In the event of default by the CONTRACTOR, the OWNER may give written notice to the CONTRACTOR of OWNER's intent to terminate the Agreement. The notice shall state the event of default and the time allowed to remedy the default. It shall be considered a default by the CONTRACTOR whenever the CONTRACTOR shall: (1) declare bankruptcy, become insolvent, or assign its assets for the benefit of its creditors; (2) fail to provide materials or workmanship meeting the requirements of the Contract Documents; (3) disregard or violate provisions of the Contract Documents or ENGINEER's

instructions, (4) fail to prosecute the WORK according to the approved progress schedule; or, (5) fail to provide a qualified superintendent, competent workmen, or materials or equipment meeting the requirements of the Contract Documents. If the CONTRACTOR fails to remedy the conditions constituting default within the time allowed, the OWNER may then issue a Notice of Termination.

B. In the event the Agreement is terminated in accordance with Paragraph 15.02A, the OWNER may take possession of the WORK and may complete the WORK by whatever method or means the OWNER may select. The cost of completing the WORK shall be deducted from the balance which would have been due the CONTRACTOR had the Agreement not been terminated and the WORK completed in accordance with the Contract Documents. If such cost exceeds the balance which would have been due, the CONTRACTOR shall pay the excess amount to the OWNER. If such cost is less than the balance which would have been due, the CONTRACTOR shall have no claim to the difference.

15.03 TERMINATION OF AGREEMENT BY OWNER (FOR CONVENIENCE)

A. The OWNER may terminate the Agreement at any time if it is found that reasons beyond the control of either the OWNER or CONTRACTOR make it impossible or against the OWNER's interests to complete the WORK. In such a case, the CONTRACTOR shall have no claims against the OWNER except: (1) for the value of the work, as determined by the engineer, performed by the Contractor up to the date the Agreement is terminated; and, (2) for the cost of materials and equipment on hand, in transit, or on definite commitment, as of the date the Agreement is terminated, which would be needed in the WORK and which meet the requirements of the Contact Documents. The value of work performed and the cost of materials and equipment delivered to the site, as mentioned above, shall be determined by the ENGINEER in accordance with the procedure prescribed from making the final application for payment and final payment under Paragraphs 14.09 and 14.10.

15.04 TERMINATION OF AGREEMENT BY CONTRACTOR

A. The CONTRACTOR may terminate the Agreement upon 10 days written notice to the OWNER, whenever: (1) the WORK has been suspended under the provisions of Paragraph 15.01, for more than 90 consecutive days through no fault or negligence of the CONTRACTOR, and notice to resume work or to terminate the agreement has not been received from the OWNER within this time period; or, (2) the OWNER should fail to pay the

CONTRACTOR any monies due him in accordance with the terms or the Contract Documents and within 60 days after presentation to the OWNER by the CONTRACTOR of a request therefor, unless within said 10-day period the OWNER shall have remedied the condition upon which the payment delay was based. In the event of such termination, the CONTRACTOR shall have no claims against the OWNER except for those claims specifically enumerated in Paragraph 15.03, and as determined in Accordance with the requirements of that paragraph.

GENERAL CONDITIONS

ARTICLE 16 - MISCELLANEOUS

16.01 GIVING NOTICE

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

16.02 TITLE TO MATERIALS FOUND ON THE WORK

A. The OWNER reserves the right to retain title to all soils, stone, sand, gravel, and other materials developed and obtained from excavations and other operations connected with the WORK. Unless otherwise specified in the Contract Documents, neither the CONTRACTOR nor any subcontractor shall have any right, title, or interest in or to any such materials. The CONTRACTOR will be permitted to use in the WORK, without charge, any such materials which meet the requirements of the Contract Documents.

16.03 RIGHT TO AUDIT

A. If the CONTRACTOR submits a claim to the OWNER for additional compensation, the OWNER shall have the right, as a condition to considering the claim, and as a basis for evaluation of the claim, and until the claim has been settled, to audit the CONTRACTOR's books. This right shall include the right to examine books, records, documents, and other evidence and accounting procedures and practices, sufficient to discover and verify all direct and indirect costs of whatever nature claimed to have been incurred or anticipated to be incurred and for which the claim has been submitted. The right to audit shall include the right to inspect the CONTRACTOR's plants, or such parts thereof, as may be or have been engaged in the performance of the WORK. The CONTRACTOR further agrees that the right to audit encompasses all subcontracts and is binding upon subcontractors. The right to examine and inspect herein provided for shall be exercisable through such representatives as the OWNER deems desirable during the CONTRACTOR's normal business hours at the office of the CONTRACTOR. The CONTRACTOR shall make available to the OWNER for auditing, all relevant accounting records and documents, and other financial data, and upon request, shall submit true copies of requested records to the OWNER.

16.04 ASBESTOS

A. If the CONTRACTOR during the course of work observes the existence of asbestos in any structure or building, the CONTRACTOR shall promptly notify the OWNER and the ENGINEER. The OWNER shall consult with the ENGINEER regarding removal or encapsulation of the asbestos material and the CONTRACTOR shall not perform any work pertinent to the asbestos material prior to receipt or special instruction from the OWNER through the ENGINEER.

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 17 - GENERAL

17.01 GENERAL

1. These Supplemental General Conditions amend or supplement the General Conditions of the Contract and any other provisions of the Contract Documents as indicated herein. All provisions which are not so amended or supplemented remain in full force and effect.

2. The terms used in these Supplemental General Conditions which are defined in the General Conditions of the Contract have the meanings assigned to them in the General Conditions of the Contract herein.

17.02 SUPPLEMENTAL DEFINITIONS

1. ENGINEER

The "Engineer" is

Jacobs Engineering
6440 South Millrock Drive, Suite 300
Holladay, UT 84121
Office: (385) 474-8564
Contact: Ryan Willeitner, P.E.
Email: ryan.willeitner@jacobs.com

17.03 TESTING COSTS

Paragraph 13.03 of the General Conditions is amended as follows: the CONTRACTOR shall pay all testing costs as outlined in Specification Section 01 45 16.13, Contractor Quality Control, and the individual specifications sections of the Contract Documents. The Owner reserves the right to have additional tests performed by a testing organization selected by the OWNER and at the OWNER’s expense.

ARTICLE 17 - GENERAL

17.04 SUPPLEMENTAL DOCUMENTATION

1. A geotechnical investigation was conducted for the 11800 South Zone C Reservoir Project. Results of this investigation are provided for the CONTRACTOR's reference in a Geotechnical Report titled:

   Geotechnical Engineering Report
   11800 South Zone C Reservoirs
   South Jordan, Salt Lake County, Utah
   Prepared by: Terracon
   Date: February 14, 2023

This report is available in electronic (PDF) format from the Engineer upon request or is available on the Jordan Valley Water Conservancy District's website at www.jvwcd.org.

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 18 - AMOUNTS OF LIQUIDATED DAMAGES, BONDS AND INSURANCE

18.01 AMOUNT OF LIQUIDATED DAMAGES

A. As provided in Article 14.07 of the General Conditions, the Contractor shall pay to the Owner as liquidated damages the amount of $1,000 for each calendar day's delay beyond the Contract Time for substantial completion, liquated damages shall apply to each site stipulated in the Contract Documents. The Contractor shall pay to the Owner as liquidated damages the amount of $200 for each calendar day's delay beyond 45 calendar days from the date of substantial Completion until the Engineer issues the Notice of Final Completion.

18.02 PERFORMANCE AND OTHER BOND AMOUNTS

A. The CONTRACTOR shall furnish a satisfactory Performance Bond in the amount of 100 percent of the Contract Price and a satisfactory Payment Bond in the amount of 100 percent of the Contract Price.

18.03 INSURANCE AMOUNTS

The limits of liability for the insurance required by Paragraph 5.02 of the General Conditions shall provide for not less than the following amounts or greater where required by Laws and Regulations:

A. Workers' Compensation under Paragraph 5.02B.1 of the General Conditions:

1. State: Utah — Statutory

B. Comprehensive General Liability: (under Paragraph 5.02B.2 of the General Conditions):

1. Bodily Injury (including completed operations and products liability):

$ 500,000 — Each Occurrence
$ 1,000,000 — Annual Aggregate

Property Damage:

$ 500,000 — Each Occurrence
$ 1,000,000 — Annual Aggregate
or a combined single limit of — $1,000,000

2. Property Damage liability insurance including, Explosion, Collapse and Underground coverages, where applicable.

3. Personal Injury, with employment exclusion deleted

$ 1,000,000 Annual Aggregate

C. Comprehensive Automobile Liability: (Under Paragraph 5.02B.3 of the General Conditions:)

1. Bodily Injury

$ 500,000 Each Person
$ 1,000,000 Each Occurrence

2. Property Damage:

$ 500,000 Each Occurrence

or combined single limit of $1,000,000

D. Builders Risk: Not required.

18.04 ADDITIONAL INSURED

Following Paragraph 5.02 of the General Conditions, the Contractor shall include the following parties or entities as additional insured:

A. Jordan Valley Water Conservancy District
8215 South 1300 West, West Jordan, Utah 84088

B. Jacobs Engineering
6440 South Millrock Drive, Suite 300, Holladay, Utah 84121

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 19 - PHYSICAL CONDITIONS AND WEATHER DELAYS

19.01 INCLEMENT WEATHER DELAYS

A. The Contractor's construction schedule shall be based upon the inclusion of at least seven (7) day(s) of inclement weather delays. Reference Article 12, paragraph 12.02 of the General Conditions for additional requirements.

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 20 - SUBCONTRACT LIMITATIONS

20.01 SUBCONTRACT LIMITATIONS

A. In addition to the provisions of Paragraph 6.05 of the General Conditions, the CONTRACTOR shall perform not less than 40 percent of the WORK with its own forces (i.e., without subcontracting). The 40 percent requirement shall be understood to refer to the WORK, the value of which totals not less than 40 percent of the Contract Price.

ARTICLE 21 - MISCELLANEOUS

21.01 PATENTS AND COPYRIGHTS

The Contractor shall indemnify and save harmless the Owner, the Engineer, and their officers, agents, and employees, against all claims or liability arising from the use of any patented or copyrighted design, device, material, or process by the Contractor or any of his subcontractors in the performance of the work.

SPECIFICATIONS

SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work to be performed under this Contract consists of furnishing all facilities, tools, equipment, materials, supplies, and manufactured articles and furnishing all labor, transportation, and services, including fuel, power, water, essential communications, permits, and performing all Work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The Work shall be complete, and all Work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete, safe and proper construction of the Work in good faith shall be provided by the Contractor within the contract time and for the bid amounts.

B. The completed Work will provide Owner with 10 million gallons of water storage at the site. The major components of this Work include the following:

1. Two 5 mg AWWA D110, Wire Wound Concrete Storage Reservoirs, with backfill around the walls and exposed roof.
2. Construction of a 48-inch and 30-inch welded steel pipelines, up to 30-inch diameter RCP drainage pipes and several smaller diameter PVC pipelines.
3. Construction of the Reservoir Valve Vault, Drainage Vault, Chlorine Building, Midas Creek Outlet and other smaller structures.
4. Mitigation of contaminated soils on the site.
5. Grading and paving of access roads and pads, and revegetation/landscaping of all disturbed areas.
6. Coordination with South Jordan City, State of Utah, Division of Drinking Water and other government and jurisdictional agencies for obtaining and compliance with the necessary permits required for construction as outlined in Section 01 51 00, Permits.
7. Hydro testing, cleaning and disinfection of the finished water reservoirs and pipelines.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 PROPOSAL REQUESTS

A. Owner may, in anticipation of ordering an addition, deletion, or revision to the Work, request Contractor to prepare a detailed proposal of cost and times to perform contemplated change.

B. Proposal request will include reference number for tracking purposes and detailed description of and reason for proposed change, and such additional information as appropriate and as may be required for Contractor to accurately estimate cost and time impact on Project.

C. Proposal request is for information only; Contractor is neither authorized to execute proposed change nor to stop Work in progress as result of such request.

D. Contractor's written proposal shall be transmitted to Engineer promptly, but not later than 14 days after Contractor's receipt of Owner's written request. Proposal shall remain firm for a maximum period of 45 days after receipt by Engineer.

E. Owner's request for proposal or Contractor's failure to submit such proposal within the required time period will not justify a Claim for an adjustment in Contract Price or Contract Times (or Milestones).

1.02 CLAIMS

A. Include, at a minimum:

1. Specific references including (i) Drawing numbers, (ii) Specification section and article/paragraph number, and (iii) Submittal type, Submittal number, date reviewed, Engineer's comment, as applicable, with appropriate attachments.
2. Stipulated facts and pertinent documents, including photographs and statements.
3. Interpretations relied upon.
4. Description of (i) nature and extent of Claim, (ii) who or what caused the situation, (iii) impact to the Work and work of others, and (iv) discussion of claimant's justification for requesting a change to price or times or both.

5. Estimated adjustment in price claimant believes it is entitled to with full documentation and justification.
6. Requested Change in Contract Times: Include at least (i) Progress Schedule documentation showing logic diagram for request, (ii) documentation that float times available for Work have been used, and (iii) revised activity logic with durations including sub-network logic revisions, duration changes, and other interrelated schedule impacts, as appropriate.
7. Documentation as may be necessary as set forth below for Work Change Directive, and as Engineer may otherwise require.

1.03 WORK CHANGE DIRECTIVES

A. Procedures:

1. Engineer will:
   a. Initiate, including a description of the Work involved and any attachments.
   b. Affix signature, demonstrating Engineer's recommendation.
   c. Transmit three copies to Owner for authorization.
2. Owner will:
   a. Affix signature, demonstrating approval of the changes involved.
   b. Return two copies to Engineer, who will retain one copy, and forward one copy to Contractor.
3. Upon completion of Work covered by the Work Change Directive or when final Contract Times and Contract Price are determined, Contractor shall submit documentation for inclusion in a Change Order.
4. Contractor's documentation shall include but not be limited to:
   a. Appropriately detailed records of Work performed to enable determination of value of the Work.
   b. Full information required to substantiate resulting change in Contract Times and Contract Price for Work. On request of Engineer, provide additional data necessary to support documentation.
   c. Support data for Work performed on a unit price or Cost of the Work basis with additional information such as:
      1) Dates Work was performed, and by whom.
      2) Time records, wage rates paid, and equipment rental rates.
      3) Invoices and receipts for materials, equipment, and subcontracts, all similarly documented.

B. Effective Date of Work Change Directive: Date of signature by Owner, unless otherwise indicated thereon.

1.04 CHANGE ORDERS

A. Procedure:

1. Engineer will prepare a digital copy of proposed Change Order and transmit such with Engineer's written recommendation and request to Contractor for signature.
2. Contractor shall, upon receipt, either: (i) promptly sign copies, retaining one for its file, and return remaining copies to Engineer for Owner's signature, or (ii) return unsigned copies with written justification for not executing Change Order.
3. Engineer will, upon receipt of Contractor signed copies, promptly forward Engineer's written recommendation and partially executed five copies for Owner's signature, or if Contractor fails to execute the Change Order, Engineer will promptly so notify Owner and transmit Contractor's justification to Owner.
4. Upon receipt of Contractor-executed Change Order, Owner will promptly either:
    a. Execute Change Order, retaining one copy for its file and returning four copies to Engineer; or
    b. Return to Engineer unsigned copies with written justification for not executing Change Order.
5. Upon receipt of Owner-executed Change Order, Engineer will transmit two copies to Contractor and retain one copy, or if Owner fails to execute the Change Order, Engineer will promptly so notify Contractor and transmit Owner's justification to Contractor.
6. Upon receipt of Owner-executed Change Order, Contractor shall:
    a. Perform Work covered by Change Order.
    b. Revise Schedule of Values to adjust Contract Price and submit with next Application for Payment.
    c. Revise Progress Schedule to reflect changes in Contract Times, if any, and to adjust times for other items of Work affected by change.
    d. Enter changes in Project record documents after completion of change related Work.

B. In signing a Change Order, Owner and Contractor acknowledge and agree that:

1. Stipulated compensation (Contract Price or Contract Times, or both) set forth includes payment for (i) the Cost of the Work covered by the Change Order, (ii) Contractor's fee for overhead and profit, (iii) interruption of Progress Schedule, (iv) delay and impact, including cumulative impact, on other Work under the Contract Documents, and (v) extended overheads.

2. Change Order constitutes full mutual accord and satisfaction for the change to the Work.
3. Unless otherwise stated in the Change Order, all requirements of the original Contract Documents apply to the Work covered by the Change Order.

1.05 FIELD ORDER

A. Engineer will issue Field Orders, with three copies to Contractor.

B. Effective date of the Field Order shall be the date of signature by Engineer, unless otherwise indicated thereon.

C. Contractor shall acknowledge receipt by signing and returning one copy to Engineer.

D. Field Orders will be incorporated into subsequent Change Orders, as a no-cost change to the Contract.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Schedule of Values: Submit on Contractor's standard form.
2. Schedule of Estimated Progress Payments:
   a. Submit with initially acceptable Schedule of Values.
   b. Submit adjustments thereto with Application for Payment.
3. Application for Payment.
4. Final Application for Payment.

1.02 SCHEDULE OF VALUES

A. Prepare a separate Schedule of Values for each schedule of the Work under the Agreement.

B. Upon request of Engineer, provide documentation to support the accuracy of the Schedule of Values.

C. Unit Price Work: Reflect unit price quantity and price breakdown from conformed Bid Form.

D. Lump Sum Work:

1. Reflect schedule of values format included in the bid form, allowances and alternates, as applicable.
2. List bonds and insurance premiums, mobilization, demobilization, preliminary and detailed progress schedule preparation, equipment testing, facility startup, and contract closeout separately.
3. Break down by Division 02 through Division 49.
4. Lump Sum items shall be broken down into individual items and components such that the cost of each item is no larger than $20,000 unless agreed upon otherwise with the Engineer.

E. An unbalanced or front-end loaded schedule will not be acceptable.

F. Summation of the complete Schedule of Values representing all the Work shall equal the Contract Price.

G. Submit Schedule of Values in a spreadsheet format compatible with latest version of Excel.

1.03 SCHEDULE OF ESTIMATED PROGRESS PAYMENTS

A. Show estimated payment requests throughout Contract Times aggregating initial Contract Price.

B. Base estimated progress payments on initially acceptable progress schedule. Adjust to reflect subsequent adjustments in progress schedule and Contract Price as reflected by modifications to the Contract Documents.

1.04 APPLICATION FOR PAYMENT

A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment for each schedule and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of Contractor.

B. Use detailed Application for Payment Form provided by Owner.

C. Provide separate form for each schedule as applicable.

D. Include accepted Schedule of Values for each schedule or portion of lump sum Work and the unit price breakdown for the Work to be paid on a unit priced basis.

E. Include separate line item for each Change Order and Work Change Directive executed prior to date of submission. Provide further breakdown of such as requested by Engineer.

F. Preparation:

1. Round values to nearest dollar.
2. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form(s) for each schedule as applicable, a listing of materials on hand for each schedule as applicable, and such supporting data as may be requested by Engineer.

1.05 MEASUREMENT—GENERAL

A. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and specifications as specified in National Institute of Standards and Technology, Handbook 44.

B. Whenever pay quantities of material are determined by weight, material shall be weighed on scales furnished by Contractor and certified accurate by state agency responsible. Weight or load slip shall be obtained from weigher and delivered to Owner's representative at point of delivery of material.

C. If material is shipped by rail, car weights will be accepted provided that actual weight of material only will be paid for and not minimum car weight used for assessing freight tariff, and provided further that car weights will not be acceptable for material to be passed through mixing plants.

D. Vehicles used to haul material being paid for by weight shall be weighed empty daily and at such additional times as required by Engineer. Each vehicle shall bear a plainly legible identification mark.

E. Materials that are specified for measurement by the cubic yard measured in the vehicle shall be hauled in vehicles of such type and size that actual contents may be readily and accurately determined. Unless all vehicles are of uniform capacity, each vehicle must bear a plainly legible identification mark indicating its water level capacity. Vehicles shall be loaded to at least their water level capacity. Loads hauled in vehicles not meeting above requirements or loads of a quantity less than the capacity of the vehicle, measured after being leveled off as above provided, will be subject to rejection, and no compensation will be allowed for such material.

F. Quantities Based on Profile Elevations: Existing ground profiles shown on Drawings were taken from a topographic map drawn with contour intervals of 1 foot with supplementary spot elevations to the nearest half foot.

G. Quantities will be based on ground profiles shown. Field surveys will not be made to confirm accuracy of elevations shown.

H. Where measurement of quantities depends on elevation of existing ground, elevations obtained during construction will be compared with those shown on Drawings. Variations of 1 foot or less will be ignored, and profiles shown on Drawings will be used for determining quantities.

I. Units of measure shown on Bid Form shall be as follows, unless specified otherwise.

Item	Method of Measurement
AC	Acre—Field Measure by Engineer
CY	Cubic Yard—Field Measure by Engineer within limits specified or shown
CY-VM	Cubic Yard—Measured in Vehicle by Volume

Item	Method of Measurement
EA	Each—Field Count by Engineer
GAL	Gallon—Field Measure by Engineer
HR	Hour
LB	Pound(s)—Weight Measure by Scale
LF	Linear Foot—Field Measure by Engineer
LS	Lump Sum—Unit is one; no measurement will be made.
SF	Square Foot
SY	Square Yard
TON	Ton—Weight Measure by Scale (2,000 pounds)

1.06 PAYMENT

A. Payment for all Lump Sum Work shown or specified in Contract Documents is included in the Contract Price. Payment will be based on a percentage complete basis for each line item of the accepted Schedule of Values.

B. Payment for Lump Sum Work covers all Work specified or shown within the limits or Specification sections and as shown on Drawings.

C. Payment for unit price items covers all the labor, materials, and services necessary to furnish and install or complete the unit price pay item.

D. The Description of lump sum and unit price items in the following tables are presented to indicate major categories of Work for purposes of comparative bid analyses and payment breakdown for monthly progress payments. Bid items are not intended to be exclusive descriptions of work categories and Contractor shall determine and include in its pricing all materials, labor, and equipment necessary to complete all of the work as shown and specified in these Contract Documents.

Schedule A	
Item	**Description**
A1. General Conditions including Bidder's Insurance and Mobilization, Demobilization & Administration	Includes all Bidder's insurance required by the Contract Documents. Includes the obtaining of all bonds, moving all equipment onto the Site; furnishing and erecting temporary construction facilities; demobilization of facilities and equipment; and administration as required for the proper performance and completion of the Work. Payment schedule will be based on the % of work completed.
A2. 5 MG AWWA D110 Reservoir	Includes reservoir preparation (subgrade material, compaction, etc.), forming, manpower, equipment, reinforcement, finishing, concrete, air vents, access hatches, stairs, ladders, sumps, pipe encasement and all other appurtenances as shown on Drawings.
A3. All Yard Piping and Pipes Inside the Reservoirs	All yard piping as shown on Drawings C-04, C-05, C-06, Leak Detection around the Reservoirs, and Piping Inside the Reservoirs (Inlet/Outlet Piping, Overflow, High Pressure Washdown etc.). Includes furnishing and installing connections to existing facilities, piping, fittings, valves; anodes for corrosion control.
A4. Valve Vault Concrete Structure and All Facilities Inside the Structure	Includes constructing a concrete vault and installing the piping equipment and appurtenances; excavation, foundation preparation and backfill; furnishing and installation of piping, valves, meters, sump, discharge piping; lights, ventilation system, access hatches, ladders, stairs; electrical and SCADA connections to the existing system; equipment and concrete testing; cleaning, disinfection of completed facilities.
A5. Chlorine Building	All work shown on Sunrise Engineering Drawing package (Volume 3 of 3) for the Chlorine Building.
A6. Other Minor Structures; Drainage Vault, Leak Detection Box, Overflow Junction, Catch Basins, Storm Drain Manhole, Drainage Outlet at Midas Creek	Similar to Item A4 for all other minor structures shown on Drawings.

Schedule A	
Item	**Description**
A7. Electrical and Instrumentation Work	As shown on Electrical, Instrumentation and Controls Drawings. Includes connection to existing meter, running conduit around the site and making all necessary existing connections.
A8. Contaminated Soil Mitigation	As outlined in the Soil Mitigation Plan to handle existing soils in the Bastian and Mascotti Ditches. This includes testing, monitoring, excavation, and storage of contaminated soils. May require hauling some material offsite for disposal based on testing.
A9. General Site Grading, Landscape, Hydroseeding, Revegetation, Fencing and Other Site Improvements	Includes all construction survey, all excavations and backfill to final grade, preconsolidated fill for West Reservoir disposal of excess soils, all other site grading work, and all final restoration/landscaping required. Includes fencing and gates around the perimeter of the site or other misc. site improvements.
A10. Roadway Installation	Subgrade preparation, base course and asphalt paving for the site.
A11. Permit Fee Allowance	This allowance amount is specifically outlined by the District for all contractor permits required for construction. Submitting receipts will be required for payment.
A12. Other Misc Items	Items shown on Drawings or Specifications that has not been covered in items A1 through A11.

1.07 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

A. Payment will not be made for following:

1. Loading, hauling, and disposing of rejected material.
2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.
4. Material not unloaded from transporting vehicle.
5. Defective Work not accepted by Owner.
6. Material remaining on hand after completion of Work.

1.08 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings and preliminary operation and maintenance data is acceptable to Engineer. Partial payments will only be made for materials stored on site that have been inspected and accepted by the Engineer.

B. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 13
PROJECT COORDINATION

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational:

1. Statement of Qualification (SOQ) for land surveyor or Civil Engineer.
2. Photographs:
   a. Digital Images: Submit on a compact disc within 5 days of being taken.
3. Video Recordings: Submit one copy within 5 days of being taken.

1.02 RELATED WORK AT SITE

A. General:

1. Other work that is either directly or indirectly related to scheduled performance of the Work under these Contract Documents, listed henceforth, is anticipated to be performed at Site by others.
2. Coordinate the Work of these Contract Documents with work of others as specified in General Conditions, Supplemental Conditions, individual specification sections, and Drawings.
3. Include sequencing constraints specified herein as a part of Progress Schedule.

B. City Standard Specifications:

1. Wherever in these Contract Documents reference is made to the City Standard Specifications, City Standard Plans, Standard Plans, or similar, said reference shall be understood as referring to the latest edition of the current “Construction Standards and Specifications for the City of South Jordan” for the restoration of South Jordan facilities damaged or destroyed as a result of project related work within the jurisdictional boundaries of South Jordan City.

2. The applicable parts of these City Standard Specifications are incorporated herein and made a part of these Documents by specific reference thereto. Materials and construction not addressed in the Contract Documents related to the restoration of City facilities damaged or destroyed as a result of project related work, shall be in conformance with these City Standard Specifications. Facilities damaged or destroyed may include but are not limited to existing facilities such as roads, curb and gutter, sidewalks, driveways, water utilities, storm drain utilities, sewer, etc.
3. If requirements contained in the City Standard Specifications are modified by or are in conflict with supplemental information in these Contract Documents, the requirements of these Contract Documents shall prevail.

1.03 UTILITY NOTIFICATION AND COORDINATION

A. Coordinate the Work with various utilities within Project limits. Notify applicable utilities prior to commencing Work, if damage occurs, or if conflicts or emergencies arise during Work.

1. Electric Company: Rocky Mountain Power.
   a. Contact Person: Ken Staples.
   b. Telephone Number: (503) 813-7152.
2. Water District: Jordan Valley Water Conservancy District.
   a. Contact Person: Troy Tucker.
   b. Telephone Number: (801) 565-4349.
3. Public Works Department: City of South Jordan.
   a. Contact Person: Ken Short.
   b. Telephone Number: (801) 254-3742.
4. Communications Lines: Verizon.
   a. Contact Person: Kirk Hansen.
   b. Telephone Number: (801) 983-1712.

1.04 PROJECT MILESTONES AND PROJECT COMPLETION DATES

A. General: Include the Milestones specified herein as a part of the Progress Schedule required under Section 01 32 00, Construction Progress Documentation.

B. Project Milestones and Completion:

1. Generally described in the Agreement Form. Following is a detailed description of each with detailed dates listed in the Bid Documents Section.

2. Substantial completion of the project including all hydrostatic testing, disinfection, valve testing and connections to the existing system shall be completed so that the pipeline and reservoirs can be operational and will be put into service. All Work will be complete, except for minor facility work that is not critical to the operation of the Owners water delivery system.
3. Final completion shall be 45 days after substantial completion in accordance with Article 14.09 of the General Conditions.

1.05 WORK SEQUENCING/CONSTRAINTS

A. Work shall be scheduled, sequenced, and performed in a manner which minimizes disruption to the public and to other construction activities around the site. The Contractor shall be responsible for the coordination and planning of its construction activities and to integrate the construction and schedule constraints into the performance of the Work.

B. Soil mitigation on the Bastian and Mascotti ditch must be completed before any other site work is performed.

C. The West Reservoir (and fill area) footprint will require soil pre-consolidation. Settlement monitoring points much be installed at the bottom of the fill and monitored before the fill is removed. This work must be completed before any permanent structures are installed at this location as outlined in Section 31 23 23, Fill and Backfill.

D. Asphalt must be placed on the site 9 months after the roadway base course (finish grade minus thickness of asphalt) has been constructed. This includes any minor adjustments to the base course because the site will have District traffic during the 9 months. If weather conditions conflict with specified placement temperatures, then the asphalt must be placed as soon as conditions are acceptable. The schedule timeline for final paving is not part of substantial or final completion.

E. All Project facilities will be substantially complete by May 1, 2026.

F. Connection to the existing system:

1. Verify the dimensions and location of the existing piping at least 14 days prior to the planned connection as specified on Drawings. Notify the Engineer of any discrepancies found before ordering the connecting pipe.

2. Install a dished head on the new facilities as shown on Drawings. Hydrostatically test and disinfect the new facilities as specified in Section 33 13 00, Disinfection of Water Utility Distribution Facilities, and Section 40 80 01, Piping Leakage Testing, at the Point of Beginning.
3. Final Connection: Following the hydrostatic testing of the reservoir and yard piping, remove the dished heads, and make the final connections. Test the joints and install field-applied linings and coatings as specified.

G. Temporary Utility Connections: Conform to Section 01 50 00, Temporary Facilities and Controls.

H. Traffic Control: As required by applicable permits and the requirements of South Jordan City.

I. Replacement and Restoration of Existing Roadways: Place permanent surface courses only between April 1 and October 15, unless authorized in writing by the Engineer. The Contractor is encouraged to complete as much of the Work within paved streets as possible and where feasible during the paving season.

1. Weather and Seasonal Limitations for Paving:
   a. Place permanent surface course only between April 15 and October 15, unless authorized in writing by the Engineer. An extended warranty period, additional pavement depth, temporary paving, and/or other considerations may be required for paving after October 15 and before April 15, and will require approval from the District and/or South Jordan City.
   b. Place permanent paving when the air temperature in the shade is above 50 degrees and rising.
   c. Do not place asphalt when frozen materials are present in the base or sub-base.
   d. For cold weather patching, emergencies, or all bituminous paving done after October 15 and before April 15 not authorized in writing by the Engineer will be considered temporary and shall be removed and replaced.
2. Temporary Surfacing:
   a. Minimum 2 inches thick, except within major intersections and other critical locations.
   b. Minimum 3 inches within close major intersections and other critical locations.
   c. Place as soon as the condition of the backfill is suitable and leave in-place until ready for permanent resurfacing.
   d. Provide temporary pavement marking as specified in Section 32 12 16, Asphalt Paving.

e. Maintain temporary surfacing and pavement markings until removal and replacement with permanent surface course.

J. Protection of Work and Property: Conform to Section 01 50 00, Temporary Facilities and Controls.

1.06 FACILITY OPERATIONS

A. Continuous operation of Owner’s facilities and pipelines is of critical importance. Schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified.

B. Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of Owner’s or Utility Companies’ operations.

C. When necessary, plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items to maintain continuous operations of Owner’s or Utility Companies’ facility.

D. Do not close lines, open or close valves, or take other action which would affect the operation of existing systems, except as specifically required by the Contract Documents and after authorization by Owner and Engineer or Utility Company. Such authorization will be considered within 48 hours after receipt of Contractor’s request.

E. Relocation of Existing Facilities:

1. During construction, it is expected that minor relocations of Work will be necessary.
2. Provide complete relocation of existing structures and Underground Facilities, including piping, utilities, equipment, structures, electrical conduit wiring, electrical duct bank, and other necessary items.
3. Use only new materials for relocated facility. Match materials of existing facility, unless otherwise shown or specified.
4. Perform relocations to minimize downtime of existing facilities.
5. Install new portions of existing facilities in their relocated position prior to removal of existing facilities, unless otherwise accepted by Engineer.

1.07 ADJACENT FACILITIES AND PROPERTIES

A. Examination:

1. After Effective Date of the Agreement and before Work at Site is started, Contractor, Engineer, and affected property owners and utility owners shall make a thorough examination of pre-existing conditions including existing buildings, structures, and other improvements in vicinity of Work, as applicable, which could be damaged by construction operations.
2. Periodic reexamination shall be jointly performed to include, but not limited to, cracks in structures, settlement, leakage, and similar conditions.

B. Documentation:

1. Record and submit documentation of observations made on examination inspections in accordance with Article Construction Photographs.
2. Upon receipt, Engineer will review, sign, and return one record copy of documentation to Contractor to be kept on file in field office.
3. Such documentation shall be used as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of Contractor’s operations, and is for the protection of adjacent property owners, Contractor, and Owner.

1.08 CONSTRUCTION PHOTOGRAPHS

A. General:

1. Photographically document all phases of the Project including preconstruction, construction progress, and post-construction.
2. Engineer shall have right to select subject matter and vantage point from which photographs are to be taken.
3. Digital Images: No post-session electronic editing of images is allowed. Stored image shall be actual image as captured without cropping or other edits.

B. Preconstruction and Post-Construction:

1. After Effective Date of the Agreement and before Work at Site is started, and again upon issuance of Substantial Completion, take a minimum of 50 photographs of Site and property adjacent to perimeter of Site.

2. Particular emphasis shall be directed to structures adjacent to the pipeline alignment and curb, gutter, storm drainage facilities, driveway approaches, and other items that are intended to be protected during construction.
3. Format: Digital, minimum resolution of 3,264 pixels by 2,448 pixels and 24-bit, millions of color.

C. Construction Progress Photos: Photographically demonstrate progress of construction, showing every aspect of Site and adjacent properties as well as interior and exterior of new or impacted structures.

D. Documentation:

1. Digital Images:
   a. Electronic image shall have date taken embedded into image.
   b. Image metadata shall include GPS location of photograph.
   c. Archive using a commercially available photo management system that provides listing of photographs including date, keyword description, and direction of photograph.
   d. Label each disk, file folders or database records with Project and Owner's name, and month and year images were produced.

1.09 AUDIO-VIDEO RECORDINGS

A. Prior to beginning Work on Site or of a particular area of the Work, and again within 10 days following date of Substantial Completion, videograph Site and property adjacent to Site.

B. In the case of preconstruction recording, no Work shall begin in the area prior to Engineer's review and approval of content and quality of video for that area.

C. Particular emphasis shall be directed to physical condition of existing vegetation, structures, and pavements within pipeline alignment and areas adjacent to and within the right-of-way or easement, and on Contractor storage and staging areas.

D. Engineer shall have right to select subject matter and vantage point from which videos are to be taken.

E. Video Format and Quality:

1. Digital format, with sound.
2. Video:
   a. Produce bright, sharp, and clear images with accurate colors, free of distortion and other forms of picture imperfections.

b. High definition recording with a minimum resolution of 1,920 pixels by 1,080 pixels at 60 frames per second.
c. Electronically, and accurately display the month, day, year, and time of day of the recording.

3. Audio:
   a. Audio documentation shall be done clearly, precisely, and at a moderate pace.
   b. Indicate date, project name, and a brief description of the location of taping, including:
      1) Facility name.
      2) Street names or easements.
      3) Addresses of private property.
      4) Direction of coverage, including engineering stationing, if applicable.

F. Documentation:

1. Audio-video Recording:
   a. Archive using a commercially available video management system that provides listing of each segment of video and the following information:
      1) Clip number (numbered sequentially, beginning with 001).
      2) Project name.
      3) Name of street(s) or easement(s) included.
      4) Applicable location by engineering stationing.
      5) Date and time of coverage.
2. Project Video Log: Maintain an ongoing log that incorporates above noted information for video clips of Project.

1.10 REFERENCE POINTS AND SURVEYS

A. Owner’s Responsibilities: The Engineer has provided established bench marks and survey control points as indicated on Drawings. These points shall serve as the horizontal and vertical control for the Work.

B. Contractor’s Responsibilities:

1. Provide additional survey and layout required to lay out the Work.
2. Notify Engineer at least 3 working days in advance of time when grade and line to be provided by Owner will be needed.
3. Check and establish exact location of existing facilities prior to construction of new facilities and any connections thereto.
4. In event of discrepancy in data or staking provided by Owner, request clarification before proceeding with Work.

5. Retain professional land surveyor registered in State of Utah who shall perform or supervise surveying necessary for additional construction staking and layout.
6. Maintain complete accurate log of survey work as it progresses as a Record Document.
7. On request of Engineer, submit documentation.
8. Provide competent employee(s), tools, stakes, and other equipment and materials as Engineer may require to:
    a. Check layout, survey, and measurement of the Work and work performed by others.
    b. Measure quantities for payment purposes.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SALVAGE OF MATERIALS

A. Salvage materials for Owner's use where shown on Drawings.

1. Remove material with extreme care so as not to damage for future use.
2. Ensure contaminated material is removed in a manner compliant with relevant standards.
3. Promptly remove salvaged materials from Work area.
4. Store materials where instructed by Owner onsite.

B. Meet with Engineer prior to starting to dismantle equipment or piping designated to be salvaged. Engineer will indicate locations where equipment is to be disconnected.

C. Provide new or repair damaged equipment or material specified or indicated to be salvaged. Clean and protect equipment from dust, dirt, natural elements, and store as directed.

3.02 CUTTING, FITTING, AND PATCHING

A. Cut, fit, adjust, or patch Work and work of others, including excavation and backfill as required, to make Work complete.

B. Obtain prior written authorization of Engineer before commencing Work to cut or otherwise alter:

1. Structural or reinforcing steel, structural column or beam, elevated slab, trusses, or other structural member.
2. Weather- or moisture-resistant elements.

3. Efficiency, maintenance, or safety of element.
4. Work of others.

C. Refinish surfaces to provide an even finish.

1. Refinish continuous surfaces to nearest intersection.
2. Refinish entire assemblies.
3. Finish restored surfaces to such planes, shapes, and textures that no transition between existing work and Work is evident in finished surfaces.

D. Restore existing work, Underground Facilities, and surfaces that are to remain in completed Work including concrete-embedded piping, conduit, and other utilities as specified and as shown on Drawings.

E. Make restorations with new materials and appropriate methods as specified for new Work of similar nature; if not specified, use recommended practice of manufacturer or appropriate trade association.

F. Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces and fill voids.

G. Remove specimens of installed Work for testing when requested by Engineer.

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

PART 1 GENERAL

1.01 GENERAL

A. Engineer will schedule physical arrangements for meetings throughout progress of the Work, prepare meeting agenda with regular participant input and distribute with written notice of each meeting, preside at meetings, record minutes to include significant proceedings and decisions, and reproduce and distribute copies of minutes within 7 days after each meeting to participants and parties affected by meeting decisions.

1.02 PRECONSTRUCTION CONFERENCE

A. Contractor shall be prepared to discuss the following subjects, as a minimum:

1. Required schedules.
2. Status of Bonds and insurance.
3. Submittal Schedule.
4. Sequencing of critical path work items.
5. Progress payment procedures.
6. Project changes and clarification procedures.
7. Use of Site, access, office and storage areas, security and temporary facilities.
8. Major product delivery and priorities.
9. Contractor’s safety plan and representative.

B. Attendees will include:

1. Owner’s representatives.
2. Contractor’s office representative.
3. Contractor’s resident superintendent.
4. Contractor’s quality control representative.
5. Subcontractors’ representatives whom Contractor may desire or Engineer may request to attend.
6. Engineer’s representatives.
7. Others as appropriate.

1.03 PRELIMINARY SCHEDULES REVIEW MEETING

A. As set forth in General Conditions and Section 01 32 00, Construction Progress Documentation.

1.04 PROGRESS MEETINGS

A. Engineer will schedule regular progress meetings at Site, conducted weekly or bi-weekly to review the Work progress, Progress Schedule, Schedule of Submittals, Application for Payment, contract modifications, and other matters needing discussion and resolution.

B. Attendees will include:

1. Owner's representative(s), as appropriate.
2. Contractor, Subcontractors, and Suppliers, as appropriate.
3. Engineer's representative(s).
4. Others as appropriate.

1.05 QUALITY CONTROL AND COORDINATION MEETINGS

A. In accordance with Section 01 45 16.13, Contractor Quality Control.

B. Scheduled by Engineer on regular basis and as necessary to review test and inspection reports, and other matters relating to quality control of the Work and work of other Contractors.

C. Attendees will include:

1. Contractor.
2. Contractor's designated quality control representative.
3. Subcontractors and Suppliers, as necessary.
4. Engineer's representative(s).
5. Owner's representatives.
6. Others as appropriate.

1.06 PREINSTALLATION MEETINGS

A. When required in individual Specification sections, convene at Site prior to commencing the Work of that section.

B. Require attendance of entities directly affecting, or affected by, the Work of that section.

C. Notify Engineer 5 days in advance of meeting date.

D. Provide suggested agenda to Engineer to include reviewing conditions of installation, preparation and installation or application procedures, and coordination with related Work and work of others.

1.07 FACILITY STARTUP MEETINGS

A. Schedule and attend a minimum of two facility startup meetings. The first of such meetings shall be held prior to submitting Facility Startup Plan, as specified in Section 01 91 14, Equipment Testing and Facility Startup, and shall include preliminary discussions regarding such plan.

B. Agenda items shall include, but not be limited to, content of Facility Startup Plan, coordination needed between various parties in attendance, and potential problems associated with startup.

C. Attendees will include:

1. Contractor.
2. Contractor's designated quality control representative.
3. Subcontractors and equipment manufacturer's representatives whom Contractor deems to be directly involved in facility startup.
4. Engineer's representatives.
5. Owner's operations personnel.
6. Others as required by Contract Documents or as deemed necessary by Contractor.

1.08 OTHER MEETINGS

A. In accordance with Contract Documents and as may be required by Owner and Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Preliminary Progress Schedule: Submit at least 7 days prior to preconstruction conference.
2. Preliminary Submittal Schedule: Submit at least 7 days prior to preconstruction conference.
3. Detailed Progress Schedule:
   a. Submit initial Detailed Progress Schedule within 30 days after Effective Date of the Agreement.
   b. Submit an Updated Progress Schedule at each update, in accordance with Article Detailed Progress Schedule.
4. Submit with Each Progress Schedule Submission:
   a. Contractor’s certification that Progress Schedule submission is actual schedule being utilized for execution of the Work.
   b. Electronic file compatible with latest version of Project Planner (P6) by Primavera Systems, Inc., unless otherwise approved by Engineer.
   c. Progress Schedule: Four legible copies.
   d. Narrative Progress Report: Same number of copies as specified for Progress Schedule.
   e. Progress Quantity Chart(s): Same number of copies as specified for Progress Schedule.
5. Prior to final payment, submit a final Updated Progress Schedule.

1.02 PRELIMINARY PROGRESS SCHEDULE

A. In addition to basic requirements outlined in General Conditions, show a detailed schedule, beginning with Notice to Proceed, for minimum duration of 90 days, and a summary of balance of Project through Final Completion.

B. Show activities including, but not limited to the following:

1. Notice to Proceed.
2. Permits.
3. Submittals, with review time. Contractor may use Schedule of Submittals specified in Section 01 33 00, Submittal Procedures.
4. Early procurement activities for long lead equipment and materials.
5. Initial Site work.

6. Earthwork.
7. Specified Work sequences and construction constraints.
8. Contract Milestone and Completion Dates.
9. Owner-furnished products delivery dates or ranges of dates.
10. Major structural, mechanical, equipment, electrical, architectural, and instrumentation and control Work.
11. System startup summary.
12. Project close-out summary.
13. Demobilization summary.

C. Update Preliminary Progress Schedule monthly as part of progress payment process. Failure to do so may result in the Owner withholding all or part of the monthly progress payment until the Preliminary Progress Schedule is updated in a manner acceptable to Engineer.

D. Format: In accordance with Article Progress Schedule—Bar Chart.

1.03 PRELIMINARY SUBMITTAL SCHEDULE

A. List all expected submittals.

B. Highlight or note submittals that will be substitute or “or-equal” items.

C. Highlight submittals that could potentially have time constraints requiring a shorter turnaround time then listed in Section 01 33 00, Submittal Procedures, that could potentially impact schedule. These submittals will be given priority in the review process.

D. Provide updates to the schedule at monthly intervals or as agreed to by the Engineer.

1.04 DETAILED PROGRESS SCHEDULE

A. In addition to requirements of General Conditions, submit Detailed Progress Schedule beginning with Notice to Proceed and continuing through Final Completion.

B. Show the duration and sequences of activities required for complete performance of the Work reflecting means and methods chosen by Contractor.

C. When accepted by Engineer, Detailed Progress Schedule will replace Preliminary Progress Schedule and become Baseline Schedule. Subsequent revisions will be considered as Updated Progress Schedules.

D. Format: In accordance with Article Progress Schedule—Bar Chart.

E. Update monthly to reflect actual progress and occurrences to date, including weather delays.

1.05 PROGRESS SCHEDULE—BAR CHART

A. General: Comprehensive bar chart schedule, generally as outlined in Associated General Contractors of America (AGC) 580, “Construction Project Planning and Scheduling Guidelines.” If a conflict occurs between the AGC publication and this Specification, this Specification shall govern.

B. Format:

1. Unless otherwise approved, white paper, 11-inch by 17-inch sheet size.
2. Title Block: Show name of project and Owner, date submitted, revision or update number, and name of scheduler.
3. Identify horizontally, across the top of the schedule, the time frame by year, month, and day.
4. Identify each activity with a unique number and a brief description of the Work associated with that activity.
5. Legend: Describe standard and special symbols used.

C. Contents:

1. Identify, in chronological order, those activities reasonably required to complete the Work, including as applicable, but not limited to the following:
    a. Obtaining permits, submittals for early product procurement, and long lead time items.
    b. Mobilization and other preliminary activities.
    c. Initial Site work.
    d. Specified Work sequences, constraints, and Milestones, including Substantial Completion date(s).
    e. Subcontract Work.
    f. Major equipment design, fabrication, factory testing, and delivery dates.
    g. Delivery dates for Owner-furnished products, as specified in Section 01 11 00, Summary of Work.
    h. Sitework.
    i. Concrete Work.
    j. Structural steel Work.
    k. Architectural features Work.
    l. Conveying systems Work.
    m. Equipment Work.
    n. Mechanical Work.
    o. Electrical Work.

p. Instrumentation and control Work.
q. Interfaces with Owner-furnished equipment.
r. Other important Work for each major facility.
s. Equipment and system startup and test activities.
t. Project closeout and cleanup.
u. Demobilization.

1.06 PROGRESS OF THE WORK

A. Updated Progress Schedule shall reflect:

1. Progress of Work to within 5 working days prior to submission.
2. Approved changes in Work scope and activities modified since submission.
3. Delays in Submittals or resubmittals, deliveries, or Work.
4. Adjusted or modified sequences of Work.
5. Other identifiable changes.
6. Revised projections of progress and completion.
7. Report of changed logic.

B. Produce detailed subschedules during Project, upon request of Owner or Engineer, to further define critical portions of the Work such as facility shutdowns.

C. If Contractor fails to complete activity by its latest scheduled completion date and this Failure is anticipated to extend Contract Times (or Milestones), Contractor shall, within 7 days of such failure, submit a written statement as to how Contractor intends to correct nonperformance and return to acceptable current Progress Schedule. Actions by Contractor to complete the Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.

D. Owner may order Contractor to increase plant, equipment, labor force or working hours if Contractor fails to:

1. Complete a Milestone activity by its completion date.
2. Satisfactorily execute Work as necessary to prevent delay to overall completion of Project, at no additional cost to Owner.

1.07 NARRATIVE PROGRESS REPORT

A. Format:

1. Organize same as Progress Schedule.
2. Identify, on a cover letter, reporting period, date submitted, and name of author of report.

B. Contents:

1. Number of days worked over the period, work force on hand, construction equipment on hand (including utility vehicles such as pickup trucks, maintenance vehicles, stake trucks).
2. General progress of Work, including a listing of activities started and completed over the reporting period, mobilization/demobilization of subcontractors, and major milestones achieved.
3. Contractor's plan for management of Site (e.g., lay down and staging areas, construction traffic), utilization of construction equipment, buildup of trade labor, and identification of potential Contract changes.
4. Identification of new activities and sequences as a result of executed Contract changes.
5. Documentation of weather conditions over the reporting period, and any resulting impacts to the work.
6. Description of actual or potential delays, including related causes, and the steps taken or anticipated to mitigate their impact.
7. Changes to activity logic.
8. Changes to the critical path.
9. Identification of, and accompanying reason for, any activities added or deleted since the last report.
10. Steps taken to recover the schedule from Contractor-caused delays.

1.08 SCHEDULE ACCEPTANCE

A. Construction Manager's acceptance will demonstrate agreement that:

1. Proposed schedule is accepted with respect to:
   a. Contract Times, including Final Completion and all intermediate Milestones are within the specified times.
   b. Specified Work sequences and constraints are shown as specified.
   c. Specified Owner-furnished Equipment or Material arrival dates, or range of dates, are included.
   d. Access restrictions are accurately reflected**.**
   e. Startup and testing times are as specified.
   f. Submittal review times are as specified.
   g. Startup testing duration is as specified and timing is acceptable.

2. In all other respects, Engineer's acceptance of Contractor's schedule indicates that, in Engineer's judgement, schedule represents reasonable plan for constructing Project in accordance with the Contract Documents. Engineer's review will not make any change in Contract requirements. Lack of comment on any aspect of schedule that is not in accordance with the Contract Documents will not thereby indicate acceptance of that change, unless Contractor has explicitly called the nonconformance to Engineer's attention in submittal. Schedule remains Contractor's responsibility and Contractor retains responsibility for performing all activities, for activity durations, and for activity sequences required to construct Project in accordance with the Contract Documents.

B. Unacceptable Preliminary Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process, during which time Contractor shall update schedule on a monthly basis to reflect actual progress and occurrences to date.

C. Unacceptable Detailed Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process.

D. Narrative Report: All changes to activity duration and sequences, including addition or deletion of activities subsequent to Engineer's acceptance of Baseline Progress Schedule, shall be delineated in Narrative Report current with proposed Updated Progress Schedule.

1.09 ADJUSTMENT OF CONTRACT TIMES

A. Reference General Conditions and Section 01 26 00, Contract Modification Procedures.

B. Evaluation and reconciliation of Adjustments of Contract Times shall be based on the Updated Progress Schedule at the time of proposed adjustment or claimed delay.

C. Schedule Contingency:

1. Contingency, when used in the context of the Progress Schedule, is time between Contractor's proposed Completion Time and Contract Completion Time.

2. Contingency included in Progress Schedule is a Project resource available to both Contractor and Owner to meet Contract Milestones and Contract Times. Use of Schedule contingency shall be shared to the proportionate benefit of both parties.
3. Use of schedule contingency suppression techniques such as preferential sequencing and extended activity times is prohibited.
4. Pursuant to Contingency sharing provisions of this Specification, no time extensions will be granted, nor will delay damages be paid until a delay occurs which (i) consumes all available contingency time, and (ii) extends Work beyond the Contract Completion date.

D. Claims Based on Contract Times:

1. Where Engineer has not yet rendered formal decision on Contractor's Claim for adjustment of Contract Times, and parties are unable to agree as to amount of adjustment to be reflected in Progress Schedule, Contractor shall reflect an interim adjustment in the Progress Schedule as acceptable to Engineer.
2. It is understood and agreed that such interim acceptance will not be binding on either Contractor or Owner, and will be made only for the purpose of continuing to schedule Work until such time as formal decision has been rendered as to an adjustment, if any, of the Contract Times.
3. Contractor shall revise Progress Schedule prepared thereafter in accordance with Engineer's formal decision.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 DEFINITIONS

A. Action Submittal: Written and graphic information submitted by Contractor that requires Engineer's approval.

B. Informational Submittal: Information submitted by Contractor that requires Engineer's review and determination that submitted information is in accordance with the Conditions of the Contract.

1.02 SUBMITTAL LIST AND SCHEDULE

A. Provide preliminary submittal list and schedule as specified in Section 01 32 00, Construction Progress Documentation.

B. Provide updates to the list and schedule as directed by the Engineer.

1.03 PROCEDURES

A. Direct submittals to Engineer at the following address, unless specified otherwise.

1. Jacobs Engineering
   Attn: Mr. Ryan Willeitner, P.E.
   6440 South Millrock Drive, Suite 300
   Holladay, UT 84121
   Telephone: (385) 474-8564

B. Electronic Submittals: Submittals shall, unless specifically accepted, be made in electronic format.

1. Each submittal shall be an electronic file in Adobe Acrobat Portable Document Format (PDF). Use the latest version available at time of execution of the Agreement.
2. Electronic files that contain more than 10 pages in PDF format shall contain internal bookmarking from an index page to major sections of the document.
3. PDF files shall be set to open "Bookmarks and Page" view.
4. Add general information to each PDF file, including title, subject, author, and keywords.

5. PDF files shall be set up to print legibly at 8-1/2-inch by 11-inch, 11-inch by 17-inch, or 22-inch by 34-inch. No other paper sizes will be accepted.
6. Submit new electronic files for each resubmittal.
7. Include a copy of the Transmittal of Contractor's Submittal form, located at end of section, with each electronic file.
8. Provide Engineer with authorization to reproduce and distribute each file as many times as necessary for Project documentation.
9. Detailed procedures for handling electronic submittals will be discussed at the preconstruction conference.

C. Transmittal of Submittal:

1. Contractor shall:
   a. Review each submittal and check for compliance with Contract Documents.
   b. Stamp each submittal with uniform approval stamp before submitting to Engineer.
      1) Stamp to include Project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with Contract Documents.
      2) Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
2. Complete, sign, and transmit with each submittal package, one Transmittal of Contractor's Submittal form attached at end of this section.
3. Identify each submittal with the following:
   a. Numbering and Tracking System:
      1) Sequentially number each submittal.
      2) Resubmission of submittal shall have original number with sequential alphabetic suffix.
   b. Specification section and paragraph to which submittal applies.
   c. Project title and Engineer's project number (WEXE9600).
   d. Date of transmittal.
   e. Names of Contractor, Subcontractor or Supplier, and manufacturer as appropriate.
4. Identify and describe each deviation or variation from Contract Documents.

D. Format:

1. Do not base Shop Drawings on reproductions of Contract Documents.
2. Package submittal information by individual Specification section. Do not combine different Specification sections together in submittal package, unless otherwise directed in Specification.
3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.
4. Index with labeled tab dividers in orderly manner.

E. Timeliness: Schedule and submit in accordance Schedule of Submittals, and requirements of individual Specification sections.

F. Processing Time:

1. Time for review shall commence on Engineer's receipt of submittal.
2. Engineer will act upon Contractor's submittal and transmit response to Contractor no later than 30 days after receipt, unless otherwise specified.
3. Resubmittals will be subject to same review time.
4. No adjustment of Contract Times or Price will be allowed due to delays in progress of Work caused by rejection and subsequent resubmittals.

G. Resubmittals: Clearly identify each correction or change made.

H. Incomplete Submittals:

1. Engineer will return entire submittal for Contractor's revision if preliminary review deems it incomplete.
2. When any of the following are missing, submittal will be deemed incomplete:
    a. Contractor's review stamp, completed and signed.
    b. Transmittal of Contractor's Submittal, completed and signed.
    c. Insufficient number of copies.

I. Submittals not required by Contract Documents:

1. Will not be reviewed and will be returned stamped "Not Subject to Review."
2. Engineer will keep one copy and return all remaining copies to Contractor.

1.04 ACTION SUBMITTALS

A. Prepare and submit Action Submittals required by individual Specification sections.

B. Shop Drawings:

1. Copies: One electronic copy or provide four hard copies when submittal material is not provided electronically. All submittals shall be electronic unless agreed to otherwise by the Owner and Engineer.
2. Identify and Indicate:
   a. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.
   b. Equipment and Component Title: Identical to title shown on Drawings.
   c. Critical field dimensions and relationships to other critical features of Work. Note dimensions established by field measurement.
   d. Project-specific information drawn accurately to scale.
3. Manufacturer's standard schematic drawings and diagrams as follows:
   a. Modify to delete information that is not applicable to the Work.
   b. Supplement standard information to provide information specifically applicable to the Work.
4. Product Data: Provide as specified in individual Specifications.
5. Foreign Manufacturers: When proposed, include following additional information.
   a. Names and addresses of at least two companies that maintain technical service representatives close to Project.
   b. Complete list of spare parts and accessories for each piece of equipment.

C. Samples:

1. Copies: Two, unless otherwise specified in individual Specifications.
2. Preparation:
   a. Mount, display, or package Samples in manner specified to facilitate review of quality. Attach label on unexposed side that includes the following:
      1) Manufacturer name.
      2) Model number.
      3) Material.
      4) Sample source.
3. Manufacturer's Color Chart: Units or sections of units showing full range of colors, textures, and patterns available.

4. Full-size Samples:
    a. Size as indicated in individual Specification section.
    b. Prepared from same materials to be used for the Work.
    c. Cured and finished in manner specified.
    d. Physically identical with product proposed for use.

D. Action Submittal Dispositions: Engineer will review, comment, stamp, and distribute as noted.

1. Approved:
    a. Contractor may incorporate product(s) or implement Work covered by submittal.
    b. Distribution. Primary distribution will be electronic. For hard copy submittals:
        1) One copy furnished Owner.
        2) One copy retained in Engineer's file.
        3) Remaining copies returned to Contractor appropriately annotated.
2. Approved as Noted:
    a. Contractor may incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
    b. Distribution. Primary distribution will be electronic. For hard copy submittals:
        1) One copy furnished Owner.
        2) One copy retained in Engineer's file.
        3) Remaining copies returned to Contractor appropriately annotated.
3. Partial Approval, Resubmit as Noted:
    a. Make corrections or obtain missing portions, and resubmit.
    b. Except for portions indicated, Contractor may begin to incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
    c. Distribution. Primary distribution will be electronic. For hard copy submittals:
        1) One copy furnished Owner.
        2) One copy retained in Engineer's file.
        3) Remaining copies returned to Contractor appropriately annotated.

4. Revise and Resubmit:
    a. Contractor may not incorporate product(s) or implement Work covered by submittal.
    b. Distribution. Primary distribution will be electronic. For hard copy submittals:
        1) One copy retained in Engineer's file.
        2) Remaining copies returned to Contractor appropriately annotated.

1.05 INFORMATIONAL SUBMITTALS

A. General:

1. Copies: One electronic copy or submit three hard copies when submittal material is not provided electronically, unless otherwise indicated in individual Specification section.
2. Refer to individual Specification sections for specific submittal requirements.
3. Engineer will review each submittal. If submittal meets conditions of the Contract, Engineer will forward copies to appropriate parties. If Engineer determines submittal does not meet conditions of the Contract and is therefore considered unacceptable, Engineer will retain one copy and return remaining copies with review comments to Contractor, and require that submittal be corrected and resubmitted.

B. Certificates:

1. General:
    a. Provide notarized statement that includes signature of entity responsible for preparing certification.
    b. Signed by officer or other individual authorized to sign documents on behalf of that entity.
2. Welding: In accordance with individual Specification sections.
3. Installer: Prepare written statements on manufacturer's letterhead certifying that installer complies with requirements as specified in individual Specification sections.
4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in individual Specification sections.

6. Manufacturer’s Certificate of Compliance: In accordance with Section 01 61 00, Common Product Requirements.
7. Manufacturer’s Certificate of Proper Installation: In accordance with Section 01 43 33, Manufacturers’ Field Services.

C. Construction Photographs and Video: In accordance with Section 01 31 13, Project Coordination, and as may otherwise be required in Contract Documents.

D. Contract Closeout Submittals: In accordance with Section 01 77 00, Closeout Procedures.

E. Contractor-Design Data:

1. Written and graphic information.
2. List of assumptions.
3. List of performance and design criteria.
4. Summary of loads or load diagram, if applicable.
5. Calculations.
6. List of applicable codes and regulations.
7. Name and version of software.
8. Information requested in individual Specification section.

F. Manufacturer’s Instructions: Written or published information that documents manufacturer’s recommendations, guidelines, and procedures in accordance with individual Specification section.

G. Operation and Maintenance Data: As required in Section 01 78 23, Operation and Maintenance Data.

H. Payment:

1. Application for Payment: In accordance with Section 01 29 00, Payment Procedures.
2. Schedule of Values: In accordance with Section 01 29 00, Payment Procedures.
3. Schedule of Estimated Progress Payments: In accordance with Section 01 29 00, Payment Procedures.

I. Quality Control Documentation: As required in Section 01 45 16.13, Contractor Quality Control.

J. Schedules:

1. Schedule of Submittals: Prepare separately or in combination with Progress Schedule as specified in Section 01 32 00, Construction Progress Documentation.
   a. Show for each, at a minimum, the following:
      1) Specification section number.
      2) Identification by numbering and tracking system as specified under Paragraph Transmittal of Submittal.
      3) Estimated date of submission to Engineer, including reviewing and processing time.
   b. On a monthly basis, submit updated schedule to Engineer if changes have occurred or resubmittals are required.
2. Progress Schedules: In accordance with Section 01 32 00, Construction Progress Documentation.

K. Special Guarantee: Supplier's written guarantee as required in individual Specification sections.

L. Statement of Qualification: Evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty Subcontractor, trade, Specialist, consultant, installer, and other professionals.

M. Submittals Required by Laws, Regulations, and Governing Agencies:

1. Promptly submit notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
2. Transmit to Engineer for Owner's records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.

N. Test, Evaluation, Inspection Reports:

1. General: Shall contain signature of person responsible for test or report.
2. Factory:
   a. Identification of product and Specification section, type of inspection or test with referenced standard or code.
   b. Date of test, Project title and number, and name and signature of authorized person.
   c. Test results.
   d. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.

e. Provide interpretation of test results, when requested by Engineer.
f. Other items as identified in individual Specification sections.

3. Field:
   a. As a minimum, include the following:
      1) Project title and number.
      2) Date and time.
      3) Record of temperature and weather conditions.
      4) Identification of product and Specification section.
      5) Type and location of test, Sample, or inspection, including referenced standard or code.
      6) Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
      7) If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
      8) Provide interpretation of test results, when requested by Engineer.
      9) Other items as identified in individual Specification sections.

O. Testing and Startup Data: In accordance with Section 01 91 14, Equipment Testing and Facility Startup.

P. Training Data: In accordance with Section 01 43 33, Manufacturers' Field Services.

1.06 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this Specification.

1. Transmittal of Contractor's Submittal Form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

JACOBS

TRANSMITTAL OF CONTRACTOR'S SUBMITTAL

(ATTACH TO EACH SUBMITTAL)

DATE: _____

TO: _____

_____

_____

_____

_____

Submittal No.: _____

☐ New Submittal ☐ Resubmittal

Project: _____

Project No.: _____

Specification Section No.: _____

(Cover only one section with each transmittal)

Schedule Date of Submittal:

_____

FROM: _____

Contractor

_____

_____

_____

SUBMITTAL TYPE: ☐ Shop Drawing ☐ Sample ☐ Informational ☐ Deferred

The following items are hereby submitted:

Number of Copies	Description of Item Submitted (Type, Size, Model Number, Etc.)	Spec. and Para. No.	Drawing or Brochure No.	Contains Variation to Contract	
				No	Yes

Contractor hereby certifies that (i) Contractor has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By: _____

Contractor (Authorized Signature)

SECTION 01 42 13
ABBREVIATIONS AND ACRONYMS

PART 1 GENERAL

1.01 REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES

A. Reference to standards and specifications of technical societies and reporting and resolving discrepancies associated therewith shall be as provided in Article 3 of the General Conditions, and as may otherwise be required herein and in the individual Specification sections.

B. Work specified by reference to published standard or specification of government agency, technical association, trade association, professional society or institute, testing agency, or other organization shall meet requirements or surpass minimum standards of quality for materials and workmanship established by designated standard or specification.

C. Where so specified, products or workmanship shall also meet or exceed additional prescriptive or performance requirements included within Contract Documents to establish a higher or more stringent standard of quality than required by referenced standard.

D. Where two or more standards are specified to establish quality, product and workmanship shall meet or exceed requirements of most stringent.

E. Where both a standard and a brand name are specified for a product in Contract Documents, proprietary product named shall meet or exceed requirements of specified reference standard.

F. Copies of standards and specifications of technical societies:

1. Copies of applicable referenced standards have not been bound in these Contract Documents.
2. Where copies of standards are needed by Contractor, obtain a copy or copies directly from publication source and maintain in an orderly manner at the Site as Work Site records, available to Contractor’s personnel, Subcontractors, Owner, and Engineer.

1.02 ABBREVIATIONS

A. Abbreviations for trade organizations and government agencies: Following is a list of construction industry organizations and government agencies to which references may be made in the Contract Documents, with abbreviations used.

1.	AA	Aluminum Association
2.	AABC	Associated Air Balance Council
3.	AAMA	American Architectural Manufacturers Association
4.	AASHTO	American Association of State Highway and Transportation Officials
5.	ABMA	American Bearing Manufacturers' Association
6.	ACI	American Concrete Institute
7.	AEIC	Association of Edison Illuminating Companies
8.	AGA	American Gas Association
9.	AGMA	American Gear Manufacturers' Association
10.	AI	Asphalt Institute
11.	AISC	American Institute of Steel Construction
12.	AISI	American Iron and Steel Institute
13.	AITC	American Institute of Timber Construction
14.	ALS	American Lumber Standards
15.	AMCA	Air Movement and Control Association
16.	ANSI	American National Standards Institute
17.	APA	APA – The Engineered Wood Association
18.	API	American Petroleum Institute
19.	APWA	American Public Works Association
20.	AHRI	Air-Conditioning, Heating, and Refrigeration Institute
21.	ASA	Acoustical Society of America
22.	ASABE	American Society of Agricultural and Biological Engineers
23.	ASCE	American Society of Civil Engineers
24.	ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
25.	ASME	American Society of Mechanical Engineers
26.	ASNT	American Society for Nondestructive Testing
27.	ASSE	American Society of Sanitary Engineering
28.	ASTM	ASTM International
29.	AWI	Architectural Woodwork Institute
30.	AWPA	American Wood Preservers' Association
31.	AWPI	American Wood Preservers' Institute
32.	AWS	American Welding Society
33.	AWWA	American Water Works Association
34.	BHMA	Builders Hardware Manufacturers' Association
35.	CBM	Certified Ballast Manufacturer
36.	CDA	Copper Development Association

37.	CGA	Compressed Gas Association
38.	CISPI	Cast Iron Soil Pipe Institute
39.	CMAA	Crane Manufacturers' Association of America
40.	CRSI	Concrete Reinforcing Steel Institute
41.	CS	Commercial Standard
42.	CSA	Canadian Standards Association
43.	CSI	Construction Specifications Institute
44.	DIN	Deutsches Institut für Normung e.V.
45.	DIPRA	Ductile Iron Pipe Research Association
46.	EIA	Electronic Industries Alliance
47.	EJCDC	Engineers Joint Contract Documents' Committee
48.	ETL	Electrical Test Laboratories
49.	FAA	Federal Aviation Administration
50.	FCC	Federal Communications Commission
51.	FDA	Food and Drug Administration
52.	FEMA	Federal Emergency Management Agency
53.	FIPS	Federal Information Processing Standards
54.	FM	FM Global
55.	Fed. Spec.	Federal Specifications (FAA Specifications)
56.	FS	Federal Specifications and Standards (Technical Specifications)
57.	GA	Gypsum Association
58.	GANA	Glass Association of North America
59.	HI	Hydraulic Institute
60.	HMI	Hoist Manufacturers' Institute
61.	IBC	International Building Code
62.	ICBO	International Conference of Building Officials
63.	ICC	International Code Council
64.	ICEA	Insulated Cable Engineers' Association
65.	IFC	International Fire Code
66.	IEEE	Institute of Electrical and Electronics Engineers, Inc.
67.	IESNA	Illuminating Engineering Society of North America
68.	IFI	Industrial Fasteners Institute
69.	IGMA	Insulating Glass Manufacturer's Alliance
70.	IMC	International Mechanical Code
71.	INDA	Association of the Nonwoven Fabrics Industry
72.	IPC	International Plumbing Code
73.	ISA	International Society of Automation
74.	ISO	International Organization for Standardization
75.	ITL	Independent Testing Laboratory
76.	JIC	Joint Industry Conferences of Hydraulic Manufacturers
77.	MIA	Marble Institute of America
78.	MIL	Military Specifications
79.	MMA	Monorail Manufacturers' Association

80.	MSS	Manufacturer's Standardization Society
81.	NAAMM	National Association of Architectural Metal Manufacturers
82.	NACE	NACE International
83.	NBGQA	National Building Granite Quarries Association
84.	NEBB	National Environmental Balancing Bureau
85.	NEC	National Electrical Code
86.	NECA	National Electrical Contractor's Association
87.	NEMA	National Electrical Manufacturers' Association
88.	NESC	National Electrical Safety Code
89.	NETA	InterNational Electrical Testing Association
90.	NFPA	National Fire Protection Association
91.	NHLA	National Hardwood Lumber Association
92.	NICET	National Institute for Certification in Engineering Technologies
93.	NIST	National Institute of Standards and Technology
94.	NRCA	National Roofing Contractors Association
95.	NRTL	Nationally Recognized Testing Laboratories
96.	NSF	NSF International
97.	NSPE	National Society of Professional Engineers
98.	NTMA	National Terrazzo and Mosaic Association
99.	NWWDA	National Wood Window and Door Association
100.	OSHA	Occupational Safety and Health Act (both Federal and State)
101.	PCI	Precast/Prestressed Concrete Institute
102.	PEI	Porcelain Enamel Institute
103.	PPI	Plastic Pipe Institute
104.	PS	Product Standards Section-U.S. Department of Commerce
105.	RMA	Rubber Manufacturers' Association
106.	RUS	Rural Utilities Service
107.	SAE	SAE International
108.	SDI	Steel Deck Institute
109.	SDI	Steel Door Institute
110.	SJI	Steel Joist Institute
111.	SMACNA	Sheet Metal and Air Conditioning Contractors National Association
112.	SPI	Society of the Plastics Industry
113.	SSPC	The Society for Protective Coatings
114.	STI/SPFA	Steel Tank Institute/Steel Plate Fabricators Association
115.	SWI	Steel Window Institute
116.	TEMA	Tubular Exchanger Manufacturers' Association
117.	TCA	Tile Council of North America
118.	TIA	Telecommunications Industry Association

119.	UBC	Uniform Building Code
120.	UFC	Uniform Fire Code
121.	UL	formerly Underwriters Laboratories Inc.
122.	UMC	Uniform Mechanical Code
123.	USBR	U.S. Bureau of Reclamation
124.	WCLIB	West Coast Lumber Inspection Bureau
125.	WI	Wood Institute
126.	WWPA	Western Wood Products Association

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 43 33
MANUFACTURERS' FIELD SERVICES

PART 1 GENERAL

1.01 DEFINITIONS

A. Person-Day: One person for 8 hours within regular Contractor working hours.

1.02 SUBMITTALS

A. Informational Submittals:

1. Training Schedule: Submit, in accordance with requirements of this specification, not less than 21 days prior to start of equipment installation and revise as necessary for acceptance.
2. Lesson Plan: Submit, in accordance with requirements of this specification, proposed lesson plan not less than 21 days prior to scheduled training and revise as necessary for acceptance.

1.03 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer. Additional qualifications may be specified in the individual specification section.

B. Representative subject to acceptance by Owner and Engineer. No substitute representatives will be allowed unless prior written approval by such has been given.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

A. Furnish manufacturers' services when required by an individual specification section, to meet the requirements of this section.

B. Where time is necessary in excess of that stated in the Specifications for manufacturers' services, or when a minimum time is not specified, the time required to perform the specified services shall be considered incidental.

C. Schedule manufacturer' services to avoid conflict with other onsite testing or other manufacturers' onsite services.

D. Determine, before scheduling services, that all conditions necessary to allow successful testing have been met.

E. Only those days of service approved by Engineer will be credited to fulfill the specified minimum services.

F. When specified in individual specification sections, manufacturer's onsite services shall include:

1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation or application procedures.
2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
3. Providing, on a daily basis, copies of all manufacturer's representatives' field notes and data to Engineer.
4. Revisiting the Site as required to correct problems and until installation and operation are acceptable to Engineer.
5. Resolution of assembly or installation problems attributable to, or associated with, respective manufacturer's products and systems.
6. Assistance during functional and performance testing, and facility startup and evaluation.
7. Training of Owner's personnel in the operation and maintenance of respective product as required.
8. Additional requirements may be listed in the individual specification sections.

3.02 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

A. When so specified, a Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this section, shall be completed and signed by the equipment manufacturer's representative.

B. Such form shall certify signing party is a duly authorized representative of the manufacturer, is empowered by the manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to assure that the equipment is complete and operational.

3.03 TRAINING

A. General:

1. Furnish manufacturers' representatives for detailed classroom and hands-on training to Owner's personnel on operation and maintenance of specified product (system, subsystem, component) and as may be required in applicable Specifications.
2. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with Owner, and familiar with operation and maintenance manual information specified in Section 01 78 23, Operation and Maintenance Data.
3. Manufacturer's representative shall be familiar with facility operation and maintenance requirements as well as with specified equipment.
4. Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.

B. Training Schedule:

1. List specified equipment and systems that require training services and show:
   a. Respective manufacturer.
   b. Estimated dates for installation completion.
   c. Estimated training dates.
2. Allow for multiple sessions when several shifts are involved.
3. Adjust schedule to ensure training of appropriate personnel as deemed necessary by Owner, and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.
4. Coordinate with Section 01 32 00, Construction Progress Documentation, and Section 01 91 14, Equipment Testing and Facility Startup.

C. Lesson Plan: When manufacturer or vendor training of Owner personnel is specified, prepare a lesson plan for each required course containing the following minimum information.

1. Title and objectives.
2. Recommended attendees (e.g., managers, engineers, operators, maintenance).
3. Course description, outline of course content, and estimated class duration.
4. Format (e.g., lecture, self-study, demonstration, hands-on).
5. Instruction materials and equipment requirements.
6. Resumes of instructors providing the training.

D. Pre-startup Training:

1. Coordinate training sessions with Owner's operating personnel and manufacturers' representatives, and with submission of operation and maintenance manuals in accordance with Section 01 78 23, Operation and Maintenance Data.
2. Complete at least 14 days prior to beginning of facility startup.

E. Post-startup Training: If required in Specifications, furnish and coordinate training of Owner's operating personnel by respective manufacturer's representatives.

3.04 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this Specification.

1. Manufacturer's Certificate of Proper Installation.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

OWNER _____ EQPT SERIAL NO:_____

EQPT TAG NO:_____ EQPT/SYSTEM:_____

PROJECT NO:_____ SPEC. SECTION:_____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- ☐ Installed in accordance with Manufacturer's recommendations.
- ☐ Inspected, checked, and adjusted.
- ☐ Serviced with proper initial lubricants.
- ☐ Electrical and mechanical connections meet quality and safety standards.
- ☐ All applicable safety equipment has been properly installed.
- ☐ Functional tests.
- ☐ System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Note: Attach any performance test documentation from manufacturer.

Comments:_____

_____

_____

_____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate his equipment and (iii) authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20___

Manufacturer:_____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

SECTION 01 45 16.13
CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D3740, Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
   b. E329, Use in the Evaluation of Testing and Inspection Agencies as Used in Construction.

1.02 DEFINITIONS

A. Contractor Quality Control (CQC): The means by which Contractor ensures that the construction, to include that performed by subcontractors and suppliers, complies with the requirements of the Contract.

1.03 SUBMITTALS

A. Informational Submittals:

1. CQC Plan: Submit, not later than 30 days after receipt of Notice to Proceed.
2. CQC Report: Submit, weekly, an original and one copy in report form.

1.04 OWNER'S QUALITY ASSURANCE

A. All Work is subject to Owner's quality assurance inspection and testing at all locations and at all reasonable times before acceptance to ensure strict compliance with the terms of the Contract Documents.

B. Owner's quality assurance inspections and tests are for the sole benefit of Owner and do not:

1. Relieve Contractor of responsibility for providing adequate quality control measures.
2. Relieve Contractor of responsibility for damage to or loss of the material before acceptance.
3. Constitute or imply acceptance.
4. Affect the continuing rights of Owner after acceptance of the completed Work.

C. The presence or absence of a quality assurance inspector does not relieve Contractor from any Contract requirement.

D. Promptly furnish all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by Engineer.

E. Owner may charge Contractor for any additional cost of inspection or test when Work is not ready at the time specified by Contractor for inspection or test, or when prior rejection makes re-inspection or retest necessary. Quality assurance inspections and tests will be performed in a manner that will not unnecessarily delay the Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Maintain an adequate inspection system and perform such inspections as will ensure that the Work conforms to the Contract Documents.

B. Maintain complete inspection records and make them available at all times to Owner and Engineer.

C. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the Contract Documents. The system shall cover all construction and demolition operations, both onsite and offsite, including Work by subcontractors, fabricators, suppliers and purchasing agents, and shall be keyed to the proposed construction sequence.

3.02 COORDINATION MEETING

A. After the Preconstruction Conference, but before start of construction, and prior to acceptance of the CQC Plan, schedule a meeting with Engineer and Owner to discuss the quality control system.

B. Develop a mutual understanding of the system details, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite Work, and the interrelationship of Contractor’s management and control with the Owner’s Quality Assurance.

C. There may be occasions when subsequent conferences may be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures that may require corrective action by Contractor.

3.03 QUALITY CONTROL ORGANIZATION

A. CQC System Manager:

1. Designate an individual within Contractor's organization who will be responsible for overall management of CQC and have the authority to act in CQC matters for the Contractor.
2. CQC System Manager may perform other duties on the Project.
3. CQC System Manager shall be an experienced construction person, with a minimum of 3 years' construction experience on similar type Work.
4. CQC System Manager shall report to the Contractor's project manager or someone higher in the organization. Project manager in this context shall mean the individual with responsibility for the overall quality and production management of the Project.
5. CQC System Manager shall be onsite during construction; periods of absence may not exceed 2 weeks at any one time.
6. Identify an alternate for CQC System Manager to serve with full authority during the System Manager's absence. The requirements for the alternate will be the same as for designated CQC System Manager.

B. CQC Staff:

1. Designate a CQC staff, available at the Site at all times during progress, with complete authority to take any action necessary to ensure compliance with the Contract. CQC staff members shall be subject to acceptance by Engineer.
2. CQC staff shall take direction from CQC System Manager in matters pertaining to QC.
3. CQC staff must be of sufficient size to ensure adequate QC coverage of Work phases, work shifts, and work crews involved in the construction. These personnel may perform other duties, but must be fully qualified by experience and technical training to perform their assigned QC responsibilities and must be allowed sufficient time to carry out these responsibilities.
4. The actual strength of the CQC staff may vary during any specific Work period to cover the needs of the Project. Add additional staff when necessary for a proper CQC organization.

C. Organizational Changes: Obtain Engineer's acceptance before replacing any member of the CQC staff. Requests for changes shall include name, qualifications, duties, and responsibilities of the proposed replacement.

3.04 QUALITY CONTROL PHASING

A. CQC shall include at least three phases of control to be conducted by CQC System Manager for all definable features of Work, as follows:

1. Preparatory Phase:
   a. Notify Owner at least 48 hours in advance of beginning any of the required action of the preparatory phase.
   b. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The CQC System Manager shall instruct applicable CQC staff as to the acceptable level of workmanship required in order to meet Contract requirements.
   c. Document the results of the preparatory phase meeting by separate minutes prepared by the CQC System Manager and attached to the QC report.
   d. Perform prior to beginning Work on each definable feature of Work:
      1) Review applicable Contract Specifications.
      2) Review applicable Contract Drawings.
      3) Verify that all materials and/or equipment have been tested, submitted, and approved.
      4) Verify that provisions have been made to provide required control inspection and testing.
      5) Examine the Work area to verify that all required preliminary Work has been completed and is in compliance with the Contract.
      6) Perform a physical examination of required materials, equipment, and sample Work to verify that they are on hand, conform to approved Shop Drawing or submitted data, and are properly stored.
      7) Review the appropriate activity hazard analysis to verify safety requirements are met.
      8) Review procedures for constructing the Work, including repetitive deficiencies.
      9) Document construction tolerances and workmanship standards for that phase of the Work.
      10) Check to verify that the plan for the Work to be performed, if so required, has been accepted by Engineer.

2. Initial Phase:
    a. Accomplish at the beginning of a definable feature of Work:
        1) Notify Owner at least 48 hours in advance of beginning the initial phase.
        2) Perform prior to beginning Work on each definable feature of Work:
            a) Review minutes of the preparatory meeting.
            b) Check preliminary Work to verify compliance with Contract requirements.
            c) Verify required control inspection and testing.
            d) Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Comparison with sample panels is appropriate.
            e) Resolve all differences.
            f) Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
        3) Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the QC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.
        4) The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.
3. Follow-up Phase:
    a. Perform daily checks to verify continuing compliance with Contract requirements, including control testing, until completion of the particular feature of Work.
    b. Daily checks shall be made a matter of record in the CQC documentation and shall document specific results of inspections for all features of Work for the day or shift.
    c. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of Work that will be affected by the deficient Work. Constructing upon or concealing nonconforming Work will not be allowed.
4. Additional Preparatory and Initial Phases: Additional preparatory and initial phases may be conducted on the same definable features of Work as determined by Owner if the quality of ongoing Work is unacceptable; or if there are changes in the applicable QC staff or in the onsite production supervision or work crew; or if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

3.05 CONTRACTOR QUALITY CONTROL PLAN

A. General:

1. Plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used.
2. An interim plan for the first 30 days of operation will be considered.
3. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of Work to be started.
4. Work outside of the features of Work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of Work to be started.

B. Content:

1. Plan shall cover the intended CQC organization for the entire Contract and shall include the following, as a minimum:
   a. Organization: Description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff will implement the three-phase control system (see Article Quality Control Phasing) for all aspects of the Work specified.
   b. CQC Staff: The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a QC function.
   c. Letters of Authority: A copy of a letter to the CQC System Manager signed by an authorized official of the firm, describing the responsibilities and delegating sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop Work which is not in compliance with the Contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities and responsibilities. Copies of these letters will also be furnished to Owner.
   d. Submittals: Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers and purchasing agents.
   e. Testing: Control, verification and acceptance testing procedures for each specific test to include the test name, frequency, specification paragraph containing the test requirements, the personnel and laboratory responsible for each type of test, and an estimate of the number of tests required.

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests, including documentation.
g. Procedures for tracking deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.
h. Reporting procedures, including proposed reporting formats; include a copy of the CQC report form.

C. Acceptance of Plans: Acceptance of the Contractor's basic and addendum CQC plans is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. Owner reserves the right to require Contractor to make changes in the CQC plan and operations including removal of personnel, as necessary, to obtain the quality specified.

D. Notification of Changes: After acceptance of the CQC plan, Contractor shall notify Engineer, in writing, a minimum of 7 calendar days prior to any proposed change. Proposed changes are subject to acceptance by Engineer.

3.06 CONTRACTOR QUALITY CONTROL REPORT

A. As a minimum, prepare a CQC report for every 7 calendar days. Account for all days throughout the life of the Contract. Reports shall be signed and dated by CQC System Manager. Include copies of test reports and copies of reports prepared by QC staff.

B. Maintain current records of quality control operations, activities, and tests performed, including the Work of subcontractors and suppliers.

C. Records shall be on an acceptable form and shall be a complete description of inspections, the results of inspections, daily activities, tests, and other items, including but not limited to the following:

1. Contractor/subcontractor and their areas of responsibility.
2. Operating plant/equipment with hours worked, idle, or down for repair.
3. Work performed today, giving location, description, and by whom. When a network schedule is used, identify each phase of Work performed each day by activity number.
4. Test and/or control activities performed with results and references to specifications/plan requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
5. Material received with statement as to its acceptability and storage.
6. Identify submittals reviewed, with Contract reference, by whom, and action taken.

7. Offsite surveillance activities, including actions taken.
8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
9. List instructions given/received and conflicts on Drawings and/or Specifications.
10. Contractor's verification statement.
11. Indicate a description of trades working on the Project; the number of personnel working; weather conditions encountered; and any delays encountered.
12. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in file work and workmanship comply with the Contract.

3.07 SUBMITTAL QUALITY CONTROL

A. Submittals shall be as specified in Section 01 33 00, Submittal Procedures. The CQC organization shall be responsible for certifying that all submittals are in compliance with the Contract requirements. Owner will furnish copies of test report forms upon request by Contractor. Contractor may use other forms as approved.

3.08 TESTING QUALITY CONTROL

A. Testing Procedure:

1. Perform tests specified or required to verify that control measures are adequate to provide a product which conforms to Contract requirements. Procure services of a licensed testing laboratory. Perform the following activities and record the following data:
    a. Verify testing procedures comply with contract requirements.
    b. Verify facilities and testing equipment are available and comply with testing standards.
    c. Check test instrument calibration data against certified standards.
    d. Verify recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
    e. Documentation:
        1) Record results of all tests taken, both passing and failing, on the CQC report for the date taken.
        2) Include specification paragraph reference, location where tests were taken, and the sequential control number identifying the test.
        3) Actual test reports may be submitted later, if approved by Engineer, with a reference to the test number and date taken.

4) Provide directly to Engineer an information copy of tests performed by an offsite or commercial test facility. Test results shall be signed by an engineer registered in the state where the tests are performed.
5) Failure to submit timely test reports, as stated, may result in nonpayment for related Work performed and disapproval of the test facility for this Contract.

B. Testing Laboratories: Laboratory facilities, including personnel and equipment, utilized for testing soils, concrete, asphalt and steel shall meet criteria detailed in ASTM D3740 and ASTM E329, and be accredited by the American Association of Laboratory Accreditation (AALA), National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), the American Association of State Highway and Transportation Officials (AASHTO), or other approved national accreditation authority. Personnel performing concrete testing shall be certified by the American Concrete Institute (ACI).

3.09 COMPLETION INSPECTION

A. CQC System Manager shall conduct an inspection of the Work at the completion of all Work or any milestone established by a completion time stated in the Contract.

B. Punchlist:

1. CQC System Manager shall develop a punchlist of items which do not conform to the Contract requirements.
2. Include punchlist in the CQC report, indicating the estimated date by which the deficiencies will be corrected.
3. CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected and so notify the Owner.
4. These inspections and any deficiency corrections required will be accomplished within the time stated for completion of the entire Work or any particular increment thereof if the Project is divided into increments by separate completion dates.

END OF SECTION

SECTION 01 45 33
SPECIAL INSPECTION, OBSERVATION, AND TESTING

PART 1 GENERAL

1.01 SUMMARY

A. This section covers requirements for Special Inspection, Observation, and Testing, required in accordance with Chapter 17 of the 2021 IBC and is in addition to and supplements requirements included in Statement of Special Inspections shown in supplement located at end of this section.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
2. International Code Council (ICC):
   a. International Building Code (IBC).
   b. Evaluation Service (ICC-ES) Reports and Legacy Reports.

1.03 DEFINITIONS

A. Agencies and Personnel:

1. Agency Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.
2. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved.
3. Registered Design Professional in Responsible Charge: An individual who is registered or licensed to practice their respective design profession as defined by statutory requirements of professional registration laws of state or jurisdiction in which Project is to be constructed.
4. Special Inspector: Qualified person employed by Owner who will demonstrate competence to the satisfaction of AHJ for inspection of a particular type of construction or operation requiring Special Inspection.

B. Statement of Special Inspections: Detailed written procedure contained in supplement located at end of this section establishing systems and components subject to Special Inspection, Observation, and Testing during construction, type and frequency of testing, extent and duration of Special Inspection, and reports to be completed and distributed by Special Inspector.

C. Special Inspection:

1. Special Inspection: Inspection required of materials, installation, fabrication, erection, or placement of components and connections requiring special expertise to ensure compliance with approved Contract Documents and referenced standards.
2. Special Inspection, Continuous: Full-time observation of work requiring Special Inspection by an approved Special Inspector who is present in area where the Work is being performed.
3. Special Inspection, Periodic: Part-time or intermittent observation of the Work requiring Special Inspection by an approved Special Inspector who is present in area where the Work has been or is being performed, and at completion of the Work.

D. Structural Systems and Components:

1. Diaphragm: Component of structural lateral load resisting system consisting of roof, floor, or other membrane or bracing system acting to transfer lateral forces to vertical resisting elements of structure.
2. Drag Strut or Collector: Component of structural lateral load resisting system consisting of diaphragm or shear wall element that collects and transfers diaphragm shear forces to vertical force-resisting elements or distributes forces within diaphragm or shear wall.
3. Seismic-Force-Resisting System: That part of structural lateral load resisting system that has been considered in the design to provide required resistance to seismic forces identified on Drawings.
4. Shear Wall: Component of structural lateral load resisting system consisting of a wall designed to resist lateral forces parallel to plane of the wall. Unless noted otherwise on Drawings, load-bearing walls with direct in-plane connections to roof and floors shall be considered to be shear walls.
5. Wind Force Resisting System: That part of the structural system that has been considered in the design to provide required resistance to wind forces identified on Drawings.

E. Nonstructural Components:

1. Architectural Component Supports: Structural members or assemblies of members which transmit loads and forces from architectural systems or components to structure, including braces, frames, struts, and attachments.
2. Electrical Component Supports: Structural members or assemblies which transmit loads and forces from electrical equipment to structure, including braces, frames, legs, pedestals, and tethers, as well as elements forged or cast as part of component for anchorage.
3. Mechanical and Plumbing Component Supports: Structural members or assemblies which transmit loads and forces from mechanical or plumbing equipment to structure, including braces, frames, skirts, legs, saddles, pedestals, snubbers, and tethers, as well as elements forged or cast as part of component for anchorage.

F. Professional Observation:

1. Does not include or waive responsibility for required Special Inspection or inspections by building official.
2. Requirements are indicated on Statement of Special Inspections provided in supplement located at the end of this section.
3. Geotechnical Observation: Visual observation of selected subgrade bearing surfaces and installation of deep foundation elements by a registered design professional for general conformance to Contract Documents.
4. Structural Observation: Visual observation of structural system(s) by a registered design professional for general conformance to Contract Documents.

1.04 SUBMITTALS

A. Informational Submittals:

1. Contractor’s Statement of Responsibility: Form shall be completed by entity responsible for construction of main seismic-force-resisting system, and seismic-resisting component listed in Statement of Special Inspections. Refer to Article Supplements located at end of section.

1.05 STATEMENT OF SPECIAL INSPECTIONS REQUIREMENTS

A. Designated Systems for Inspection:

1. Seismic-force-resisting systems designated under IBC Section 1705 and subject to Special Inspection under Section 1705: See Drawings for basic lateral load resisting systems for each structure and other designated seismic systems.
2. Wind-force-resisting systems designated under IBC Section 1705: None required.
3. Architectural, Plumbing, Mechanical, and Electrical Components subject to Special Inspection under IBC Section 1705.12.5, and Section 1705.12.6, for Seismic Resistance: None required.

B. Statement of Special Inspections:

1. As included in supplement located at the end of this section and in support of building permit application, Project-specific requirements were prepared by Registered Design Professional in Responsible Charge. The following identifies elements of inspection, observation, and testing program to be followed in construction of the Work:
   a. Designated seismic systems and main seismic force-resisting systems and components that are subject to Special Inspection and Structural Observation for lateral load resistance.
   b. Special Inspection and testing required by IBC Section 1705 and other applicable sections and referenced standards therein.
   c. Type and frequency of Special Inspection required.
   d. Type and frequency of testing required.
   e. Required frequency and distribution of testing and Special Inspection reports to be distributed by Special Inspector to Engineer, Contractor, building official, and Owner.
   f. Geotechnical Observation to be Performed: Required frequency and distribution of Geotechnical Observation reports by registered design professional to Contractor, building official, and Owner.
   g. Structural Observations to be Performed: Required frequency and distribution of Structural Observation reports by registered design professional to Contractor, building official, and Owner.

C. Special Inspection and associated testing of shop fabrication and field construction will be performed by an approved accredited independent agency or by Authority Having Jurisdiction’s (AHJ) approved, qualified inspection staff. Owner will secure and pay for services of agency to perform Special Inspection and associated testing.

D. Code required Special Inspection with associated testing and Professional Observation, as provided in Statement of Special Inspections in supplement located at the end of this section and further provided in this section, is for benefit of Owner and does not:

1. Relieve Contractor of responsibility for providing adequate quality control measures.
2. Relieve Contractor of responsibility for damage to or loss of material before acceptance.
3. Constitute or imply acceptance.
4. Affect continuing rights of Owner after acceptance of completed Work.

E. The presence or absence of code required Special Inspector and Professional Observer does not relieve Contractor from Contract requirements.

F. Contractor is responsible for additional costs associated with Special Inspection and Testing and Observation when Work is not ready at time identified by Contractor and Special Inspectors and Professional Observer are onsite, but not able to provide contracted services.

G. Contractor is responsible for associated costs for additional Special Inspection and Testing and Professional Observation by Special Inspectors and Professional Observers required because of rejection of materials of in place Work that cannot be made compliant to Contract Document without additional inspections and observation and testing.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Requirements of the Statement of Special Inspections are provided by the Owner. All other testing and inspections, unless noted otherwise, are provided by Contractor.

B. Provide access to shop or Site for Special Inspection and Testing and Professional Observation requirements.

C. Notify Engineer in advance of required Special Inspection and Professional Observation no later than 72 hours prior to date of Special Inspection and Professional Observation.

D. Provide access for Special Inspector to construction documents.

E. Retain special inspection records on-site to be readily available for review.

F. Cooperate with Special Inspector and provide safe access to the Work to be inspected.

G. Submit Fabricator's Certificates of Compliance for approved fabricators.

H. Provide reasonable auxiliary services as requested by the Special Inspector. Auxiliary services required include, but not limited to:

1. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests to assist the Special Inspector in performing test/inspections.
2. Providing storage space for the Special Inspector’s exclusive use, such as for storing and curing concrete test samples and delivery of samples to testing laboratories.
3. Providing the Special Inspector with access to all approved submittals.
4. Providing security and protection of samples and test equipment at the Project Site.
5. Provide samples of materials to be tested in required quantities.

I. Materials and systems shall be inspected during placement where Continuous Special Inspection is required.

J. Where Periodic Special Inspection is indicated in the Statement of Special Inspections:

1. Schedule inspections for either during or at completion of their placement or a combination or both.
2. Schedule periodically inspected Work (either inspected during or after its placement) so that corrections can be completed and re-inspected before Work is inaccessible.
3. Sampling a portion of the Work is not allowed. Schedules shall provide for inspection of all Work requiring periodic inspection.

3.02 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are a part of this Specification.

1. Contractor’s Statement of Responsibility.
2. Statement of Special Inspections.

END OF SECTION

CONTRACTOR'S STATEMENT OF RESPONSIBILITY

_____
(Project)

_____
(Name of Contracting Company)

_____
(Business Address)

(_____) _____ (_____) _____
(Telephone) (Fax)

I, (We) hereby certify that I am (we are) aware of the Special Inspection and Testing and Professional Observation requirements contained in Contract Documents for this Project for seismic force-resisting systems, and for components including architectural, mechanical, and electrical components, as listed in Statement of Special Inspections in supplement located at the end of this section and that:

1. I, (We) aware of the systems and the requirements of the special inspection and acknowledge our responsibility in the implementation of the Statement of Special Inspections for the construction of the following systems:

Facility	Lateral Force-Resisting System
Reservoir Valve Vaults	Flat-bottom, ground-supported, reinforced concrete with reinforced nonsliding base tank
Reservoir	Flat-bottom, ground-supported, prestressed concrete with anchored flexible base tank

3. Control of this Work will be exercised to obtain conformance with Contract Documents approved by building official.

4. Procedures within the Contractor's organization to be used for exercising control of the Work, method and frequency of reporting, and distribution of reports required under Statement of Special Inspections for Project are attached to this statement.

5. I, (We) will provide 48-hour notification to Engineer and approved inspection agency as required for structural tests and Special Inspection for Project.

6. The following person is hereby identified as exercising control over requirements of this section for the Work designated above:

Name: _____

Qualifications: _____

_____

_____

(Print name and official title of person signing this form)

Signed by: _____

Date: _____

Project Name: _____

STATEMENT OF SPECIAL INSPECTIONS

GENERAL NOTES

1. THE STATEMENT OF SPECIAL INSPECTIONS PROVIDE PROJECT COMPLIANCE WITH THE PROVISIONS OF THE 2021 INTERNATIONAL BUILDING CODE (IBC) CHAPTER 17 FOR SPECIAL INSPECTION, STRUCTURAL OBSERVATION, AND TESTING FOR WIND AND SEISMIC RESISTANCE AS APPLICABLE. EXCEPT WHERE OTHERWISE NOTED, THIS INSPECTION IS OWNER FURNISHED.
2. STANDARD SPECIAL INSPECTION REQUIREMENTS FOR NONSTRUCTURAL COMPONENTS ARE CONTAINED IN TABLE 1.
3. STANDARD SPECIAL INSPECTION REQUIREMENTS FOR STRUCTURAL COMPONENTS, REGARDLESS OF WIND OR SEISMIC DESIGN CATEGORIES, ARE CONTAINED IN TABLE 2. STANDARD TESTING REQUIREMENTS FOR STRUCTURAL COMPONENTS ARE CONTAINED IN TABLE 3.
4. PROJECT SPECIFIC REQUIREMENTS FOR STRUCTURES ASSIGNED TO SEISMIC DESIGN CATEGORIES C, D, E, OR F ARE CONTAINED IN TABLE 4. ADDITIONAL TESTING REQUIREMENTS FOR STRUCTURAL RESISTANCE ARE CONTAINED IN TABLE 6.
5. PROJECT SPECIFIC REQUIREMENTS FOR STRUCTURES SUBJECT TO BASIC WIND SPEEDS [(V_{asd})] IN EXCESS OF 110 MPH ARE CONTAINED IN TABLE 5.
6. FOR ADDITIONAL REQUIREMENTS, REFER TO SPECIFICATION SECTION 01 45 33, SPECIAL INSPECTION, OBSERVATION, AND TESTING. THESE INCLUDE:
   A. CONTRACTOR'S REQUIREMENTS TO PROVIDE ACCESS TO THE WORK FOR REQUIRED INSPECTIONS, AND TO PROVIDE NOTICE OF REQUIRED INSPECTIONS AND STRUCTURAL OBSERVATION.
   B. CONTRACTOR'S STATEMENT OF RESPONSIBILITY FOR WORK TO BE PERFORMED ON SYSTEMS DESIGNATED UNDER THE STATEMENT OF SPECIAL INSPECTIONS FOR WIND OR SEISMIC RESISTANCE.
   C. DEFINITIONS AND TERMINOLOGY USED IN THIS STATEMENT OF SPECIAL INSPECTIONS.

SPECIAL INSPECTION

1. SPECIAL INSPECTION WILL BE IN ACCORDANCE WITH IBC SECTIONS 1704 AND 1705 TOGETHER WITH LOCAL AND STATE AMENDMENTS. REFER TO THE FOLLOWING TABLES FOR PROJECT SPECIFIC INSPECTION TYPES AND FREQUENCIES.
2. SPECIAL INSPECTIONS WILL BE PROVIDED BY A CERTIFIED OR QUALIFIED INSPECTOR AND ASSOCIATED TESTING WILL BE PERFORMED BY AN

APPROVED ACCREDITED INDEPENDENT AGENCY. THE OWNER WILL SECURE AND PAY FOR THE SERVICES OF THE AGENCY TO PERFORM ALL SPECIAL INSPECTION AND ASSOCIATED TESTS. INSPECTORS FOR EACH SYSTEM AND MATERIAL WILL BE INTERNATIONAL CODE COUNCIL (ICC) CERTIFIED OR OTHERWISE APPROVED BY THE BUILDING OFFICIAL.

3. THE SPECIAL INSPECTOR WILL OBSERVE THE INDICATED WORK FOR COMPLIANCE WITH THE APPROVED CONTRACT DOCUMENTS AND SUBMIT RECORDS OF INSPECTION. ALL DISCREPANCIES WILL BE BROUGHT TO THE IMMEDIATE ATTENTION OF THE CONTRACTOR FOR CORRECTION.
4. SPECIAL INSPECTION AND ASSOCIATED TESTING REPORTS WILL BE SUBMITTED TO THE ENGINEER, CONTRACTOR, BUILDING OFFICIAL, AND OWNER WITHIN ONE WEEK OF INSPECTION OR WITHIN ONE WEEK OF TEST COMPLETION. INSPECTIONS FOR WHICH REPORTING WILL BE REQUIRED ARE NOTED IN THE FOLLOWING TABLES.
5. AT THE CONCLUSION OF CONSTRUCTION, A FINAL REPORT DOCUMENTING REQUIRED SPECIAL INSPECTIONS AND CORRECTION OF PREVIOUSLY NOTED DISCREPANCIES WILL BE SUBMITTED.

GEOTECHNICAL OBSERVATION

1. ALL FOUNDATION BEARING SURFACES SHALL BE INSPECTED BY GEOTECHNICAL ENGINEER PRIOR TO PLACEMENT OF REINFORCING STEEL. ADDITIONAL SPECIAL INSPECTION REQUIREMENTS ARE LISTED IN TABLE 1.
2. GEOTECHNICAL TESTING REQUIREMENTS ARE LISTED IN TABLE 3.

STRUCTURAL OBSERVATION

1. STRUCTURAL OBSERVATION WILL BE IN ACCORDANCE WITH IBC SECTION 1704.6 TOGETHER WITH LOCAL AND STATE AMENDMENTS.
2. ONSITE STRUCTURAL OBSERVATION WILL BE PERFORMED FOR EACH IDENTIFIED SEISMIC FORCE- OR WIND FORCE-RESISTING SYSTEM, INCLUDING FOUNDATIONS AND CONNECTIONS. REFER TO THE INDIVIDUAL STRUCTURAL DRAWINGS FOR THE BASIC SEISMIC AND WIND FORCE-RESISTING SYSTEMS FOR THE STRUCTURES INCLUDED IN THE WORK.
3. STRUCTURAL OBSERVATION WILL BE PERFORMED BY A REGISTERED PROJECT DESIGN PROFESSIONAL FOR GENERAL CONFORMANCE TO THE APPROVED CONSTRUCTION DOCUMENTS. STRUCTURAL OBSERVATION DOES NOT INCLUDE OR WAIVE THE RESPONSIBILITY FOR ANY REQUIRED SPECIAL INSPECTIONS OR INSPECTIONS BY THE BUILDING OFFICIAL.

4. STRUCTURAL OBSERVATION REPORTS, NOTING ANY DEFICIENCIES IN OBSERVED CONSTRUCTION, WILL BE DELIVERED TO THE CONTRACTOR, BUILDING OFFICIAL, AND OWNER FOLLOWING EACH OBSERVATION. THE CONTRACTOR WILL BE NOTIFIED ONSITE OR BY PHONE OR E-MAIL WITHIN 24 HOURS UPON FINDING DEFICIENCIES.
5. AT THE CONCLUSION OF CONSTRUCTION, A WRITTEN STATEMENT WILL BE PROVIDED TO VERIFY THAT THE STRUCTURAL OBSERVATION SITE VISITS WERE MADE AND WHETHER THERE REMAIN ANY STRUCTURAL DEFICIENCIES THAT HAVE NOT BEEN RESOLVED.
6. STRUCTURAL OBSERVATION WILL INCLUDE VISUAL OBSERVATION OF THE STRUCTURAL SYSTEM AT SIGNIFICANT CONSTRUCTION STAGES AND AT COMPLETION OF THE STRUCTURAL SYSTEM FOR EACH STRUCTURE CONTAINED IN THE WORK. THE CONTRACTOR SHALL SCHEDULE AND FACILITATE STRUCTURAL OBSERVATION, INCLUDING THE ELEMENTS DESCRIBED IN THE STRUCTURAL OBSERVATION TABLES (ATTACHED).

SPECIAL INSPECTIONS FOR WIND RESISTANCE

1. SPECIAL INSPECTIONS REQUIREMENTS FOR WIND RESISTANCE IN ACCORDANCE WITH IBC SECTION 1705.11 ARE NOT APPLICABLE TO THIS PROJECT.

SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE

1. SPECIAL INSPECTIONS REQUIREMENTS FOR SEISMIC RESISTANCE WILL BE IN ACCORDANCE WITH IBC SECTION 1705.12 AND 1705.13 TOGETHER WITH LOCAL AND STATE AMENDMENTS. REFER TO INDIVIDUAL STRUCTURE DRAWINGS FOR BASIC SEISMIC-FORCE-RESISTING SYSTEMS FOR EACH STRUCTURE AND DESIGNATED SEISMIC DESIGN CATEGORY.
2. SPECIAL INSPECTIONS REQUIREMENTS FOR SEISMIC RESISTANCE SHALL APPLY TO THE SYSTEMS AND COMPONENTS LISTED IN TABLE 4.
3. MAIN SYSTEMS REQUIRED TO BE COVERED UNDER PROJECT SPECIAL INSPECTION REQUIREMENTS INCLUDE THE FOLLOWING TOGETHER WITH THEIR CONNECTIONS. REFER TO SECTION 01 45 33, SPECIAL INSPECTION, OBSERVATION AND TESTING.
    A. Reservoir.
    B. Reservoir Valve Vaults.

STRUCTURAL OBSERVATION TABLE

	SYSTEM FOR RESERVOIRS AND VAULTS	STAGE	ITEMS	COMMENTS
1.	FOUNDATION SLAB OF STRUCTURE	PRIOR TO FIRST CONCRETE PLACEMENT OF FIRST SECTION WHEN ITEMS CAN STILL BE REVISED	REINFORCING STEEL, CONCRETE WALL DOWELS, WATERSTOPS, EMBEDS, AND SIMILAR ITEMS	NOTE 1
2.	CONCRETE WALLS OF STRUCTURE	PRIOR TO FIRST CONCRETE PLACEMENT OF FIRST SECTION WHEN ITEMS CAN STILL BE REVISED	REINFORCING STEEL, WALL DOWELS, WATERSTOPS, EMBEDS, AND SIMILAR ITEMS	NOTE 1
3.	WALL TO FOUNDATION CONNECTIONS PRIOR TO FORM CLOSURE	PRIOR TO FIRST CONCRETE PLACEMENT OF FIRST SECTION WHEN ITEMS CAN STILL BE REVISED		NOTE 1
4.	ELEVATED CONCRETE SLAB PRIOR TO CONCRETE PLACEMENT	PRIOR TO FIRST CONCRETE PLACEMENT OF FIRST SECTION WHEN ITEMS CAN STILL BE REVISED	REINFORCING STEEL, WATERSTOPS, EMBEDS, AND SIMILAR ITEMS	NOTE 1
5.	CONCRETE STRUCTURES	PRIOR TO FIRST CONCRETE PLACEMENT ON FIRST LIQUID HOLDING STRUCTURE WHEN ITEMS CAN STILL BE REVISED	REINFORCING STEEL, WALL DOWELS, WATERSTOPS, EMBEDS, AND SIMILAR ITEMS	NOTE 1
6.	CONCRETE STRUCTURES	AT COMPLETION OF PLACEMENT OF ALL CONCRETE COMPONENTS FOR THE FIRST LIQUID HOLDING STRUCTURE	CONCRETE TOLERANCES, FINISHING, LIQUID TIGHTNESS, AND SIMILAR ITEMS	NOTE 1
7.	CONCRETE WALL TO FLOOR AND ROOF CONNECTIONS (VAULTS)	PRIOR TO FORM CLOSURE OR OTHER COVER		NOTE 1
8.	AT ADDITIONAL TIMES DURING CONSTRUCTION AT WHICH THE ENGINEER OF RECORD OR OWNER DEEM THE NEED FOR ADDITIONAL STRUCTURAL OBSERVATION			NOTE 1

9.	AT SUBSTANTIAL COMPLETION OF PRIMARY STRUCTURAL SYSTEM FOR DETERMINATION OF FINAL CONDITION OF STRUCTURE			NOTE 1

NOTES:

1. STRUCTURAL OBSERVER TO DISCUSS ITEMS AND SITE SPECIFIC CONDITIONS WITH SPECIAL INSPECTOR AND FIELD INSPECTION STAFF DURING OBSERVATION.

TABLE 1
REQUIRED NON-STRUCTURAL SPECIAL INSPECTION
REFER TO SPECIFICATION SECTION 01 45 33

SYSTEM OR MATERIAL	2021 IBC CODE REFERENCE	REFERENCED STANDARD	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
GEOTECHNICAL						
1. SOILS:						
A. VERIFY MATERIALS BELOW SHALLOW FOUNDATIONS ARE ADEQUATE TO ACHIEVE THE DESIGN BEARING CAPACITY	1705.6, 1803.5.8, 1803.5.9, 1804.6, 1804.7	SECTION 31 23 13, SUBGRADE PREPARATION	X		PROFESSIONAL OBSERVATION BY GEOTECHNICAL ENGINEER	
B. VERIFY EXCAVATIONS ARE EXTENDED TO PROPER DEPTH AND HAVE REACHED PROPER MATERIAL	1705.6	SECTION 31 23 16, EXCAVATION	X		PROFESSIONAL OBSERVATION BY GEOTECHNICAL ENGINEER	
C. PERFORM CLASSIFICATION AND TESTING OF COMPACTED FILL MATERIALS	1705.6	SECTION 31 23 23, FILL AND BACKFILL	X			SEE TABLE 3 FOR GRADATION TEST REQUIREMENTS
D.DURING FILL PLACEMENT, VERIFY USE OF PROPER MATERIALS AND PROCEDURES IN ACCORDANCE WITH THE PROVISIONS OF THE APPROVED GEOTECHNICAL REPORT. VERIFY DENSITIES, AND LIFT THICKNESSES DURING PLACEMENT AND COMPACTION OF COMPACTED FILL	1705.6, 1803.5.8	SECTION 31 23 23, FILL AND BACKFILL		X		SEE TABLE 3 FOR DENSITY TEST REQUIREMENTS

E. PRIOR TO PLACEMENT OF COMPACTED FILL, INSPECT SUBGRADE AND VERIFY THAT SITE HAS BEEN PREPARED PROPERLY	1705.6	SECTION 31 23 13, SUBGRADE PREPARATION	X		PROFESSIONAL OBSERVATION BY GEOTECHNICAL ENGINEER	SEE TABLE 3 FOR DENSITY TEST AND PROOF ROLLING REQUIREMENTS
GENERAL						
1. CONSTRUCTION MATERIALS AND SYSTEMS THAT ARE ALTERNATIVES TO MATERIALS AND SYSTEMS PRESCRIBED BY CODE	1705.1.1 ITEM 1		X			
2. INSTALLATION OF MATERIALS THAT REQUIRE ADDITIONAL MANUFACTURER'S INSTRUCTIONS BEYOND CODE REQUIREMENTS	1703.4.2, 1705.1.1 ITEM 3	ICC-ES EVALUATION REPORTS		X		
STRUCTURAL						
SEE TABLE 2.						

NOTES:

1. PERIODIC INSPECTION IS DEFINED AS INSPECTION BY THE SPECIAL INSPECTOR OF ALL MATERIALS AND SYSTEMS, IN SOME CASES PERFORMED DURING THEIR PLACEMENT AND IN ALL CASES PERFORMED UPON COMPLETION OF THEIR PLACEMENT. THE COMPLETION INSPECTION SHALL BE PERFORMED SO THAT WORK CAN BE CORRECTED PRIOR TO OTHER RELATED WORK PROCEEDING AND COVERING INSPECTED WORK.

TABLE 2
REQUIRED STRUCTURAL SPECIAL INSPECTION
REFER TO SPECIFICATION SECTION 01 45 33

SYSTEM	2021 IBC CODE REFERENCE	REFERENCED STANDARD	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
CONCRETE						
1. INSPECT REINFORCEMENT, INCLUDING PRESTRESSING TENDONS, AND VERIFY PLACEMENT	1705.3	ACI 318: Ch. 20, 25.2, 25.3, 26.6.1-26.6.3	X			SEE TABLE 6 FOR REINFORCING STEEL TESTING
2. REINFORCING BAR WELDING						
A. VERIFY WELDABILITY OF REINFORCING BARS OTHER THAN ASTM A706	1705.3	AWS D1.4 ACI 318: 26.6.4	X			
B. INSPECT SINGLE-PASS FILLET WELDS, MAXIMUM 5/16"	1705.3	AWS D1.4 ACI 318: 26.6.4	X			
C. INSPECT ALL OTHER WELDS	1705.3	AWS D1.4 ACI 318: 26.6.4		X		
3. INSPECT ANCHORS CAST IN CONCRETE	1705.3	ACI 318: 26.13.3.3	X			
4. INSPECT ANCHORS POST-INSTALLED IN HARDENED CONCRETE MEMBERS						

A. ADHESIVE ANCHORS INSTALLED IN HORIZONTALLY OR UPWARDLY INCLINED ORIENTATIONS TO RESIST SUSTAINED TENSION LOADS	1705.3	ACI 318: 26.13.3.2, ICC-ES EVALUATION REPORTS		X		
B. MECHANICAL ANCHORS AND ADHESIVE ANCHORS NOT DEFINED IN 4A.	1705.3	ACI 318: 26.13.3.3, ICC-ES EVALUATION REPORTS	X			
5. VERIFY USE OF REQUIRED DESIGN MIX	1705.3, 1904.1, 1904.2, 1908.1	ACI 318: Ch. 19, 26.4.3, 26.4.4	X			
6. PRIOR TO CONCRETE PLACEMENT, FABRICATE SPECIMENS FOR STRENGTH TESTS, PERFORM SLUMP AND AIR CONTENT TESTS, AND DETERMINE THE TEMPERATURE OF THE CONCRETE	1705.3, 1908.1	ASTM C 172, ASTM C 31, ACI 318: 26.5, 26.12		X		SEE TABLE 3 FOR CONCRETE TEST REQUIREMENTS
7. INSPECT CONCRETE AND SHOTCRETE PLACEMENT FOR PROPER APPLICATION TECHNIQUES	1705.3, 1908.1	ACI 318: 26.5.1.1, 26.5.2.1		X		
8. VERIFY MAINTENANCE OF SPECIFIED CURING TEMPERATURE AND TECHNIQUES	1705.3, 1908.1	ACI 318: 26.5.3-26.5.5	X			

9. INSPECT PRESTRESSED CONCRETE:						
A. APPLICATION OF PRESTRESSING FORCES	1705.3	ACI 318: 26.10		X		
10. VERIFY IN-SITU CONCRETE STRENGTH, PRIOR TO STRESSING OF TENDONS IN POST-TENSIONED CONCRETE AND PRIOR TO REMOVAL OF SHORING AND FORMS FROM BEAMS AND STRUCTURAL SLABS	1705.3	ACI 318: 26.11.2	X			
11. INSPECT FORMWORK FOR SHAPE, LOCATION AND DIMENSIONS OF THE CONCRETE MEMBER BEING FORMED	1705.3	ACI 318: 26.11.1.2(b)	X			
12. INSPECTION OF WATERSTOPS FOR PROPER SHAPE, LOCATION, JOINT QUALITY, AND SURROUNDING CONCRETE PLACEMENT		ACI: 26.5.6.2	X			
13. VERIFY PROPER INSTALLATION OF MECHANICAL REINFORCING SPLICES AND CONNECTIONS	1705.1.1 ITEM 3, 1705.3	ICC-ES EVALUATION REPORTS	X			

STRUCTURAL STEEL						
1. MATERIAL VERIFICATION OF STRUCTURAL STEEL:						
A. IDENTIFICATION MARKINGS TO CONFORM TO AISC 360	1705.2.1, 2202.1	Applicable ASTM Material Standards	X			
B. MANUFACTURER'S CERTIFIED TEST REPORTS	1705.2.1	AISC 360: Sec. N3.2, N5.2	X			
2. PRIOR TO BOLTING, VERIFY THAT THE FOLLOWING ARE IN COMPLIANCE:						
A. MANUFACTURER'S CERTIFICATIONS AVAILABLE FOR FASTENER MATERIALS	1705.2.1	AISC 360: Sec. N3.2, N5.2, N5.6 RCSC: Sec. 2.1, 9.1		X		
B. FASTENERS MARKED IN ACCORDANCE WITH ASTM REQUIREMENTS	1705.2.1	AISC 360: Sec. N3.2, N5.2, N5.6 Applicable ASTM Material Standards	X			
C. CORRECT FASTENERS SELECTED FOR THE JOINT DETAIL (GRADE, TYPE, BOLT LENGTH IF THREADS ARE TO BE EXCLUDED FROM THE SHEAR PLANE)	1705.2.1	AISC 360: Sec. N3.2, N5.2, N5.6	X			
D. CORRECT BOLTING PROCEDURE SELECTED FOR JOINT DETAIL	1705.2.1	AISC 360: Sec. N5.6 RCSC: Sec. 4	X			

E. CONNECTING ELEMENTS, INCLUDING THE APPROPRIATE FAYING SURFACE CONDITION AND HOLE PREPARATION, IF SPECIFIED, MEET APPLICABLE REQUIREMENTS	1705.2.1	AISC 360: Sec. N5.6 RCSC: Sec. 3.2, 4	X			
F. PRE-INSTALLATION VERIFICATION TESTING BY INSTALLATION PERSONNEL OBSERVED AND DOCUMENTED FOR FASTENER ASSEMBLIES AND METHODS USED	1705.2.1	AISC 360: Sec. N5.6 RCSC: Sec. 7	X			
G. PROTECTED STORAGE PROVIDED FOR BOLTS, NUTS, WASHERS AND OTHER FASTENER COMPONENTS	1705.2.1	AISC 360: Sec. N5.6 RCSC: Sec. 2.2	X			
3. VERIFY DURING BOLTING:						
A. FASTENER ASSEMBLIES PLACED IN ALL HOLES AND WASHERS (IF REQUIRED) AND NUTS ARE POSITIONED AS REQUIRED	1705.2.1	AISC 360: Sec. N5.6	X			
B. JOINT BROUGHT TO SNUG-TIGHT CONDITION PRIOR TO THE PRETENSIONING OPERATION	1705.2.1	AISC 360: Sec. N5.6	X			

C. FASTENER COMPONENT NOT TURNED BY THE WRENCH PREVENTED FROM ROTATING	1705.2.1	AISC 360: Sec. N5.6	X			
D. FASTENERS ARE PRETENSIONED IN ACCORDANCE WITH THE RCSC SPECIFICATION, PROGRESSING SYSTEMATICALLY FROM THE MOST RIGID POINT TOWARD THE FREE EDGES	1705.2.1	AISC 360: Sec. N5.6	X			SEE TABLE 3 FOR TESTING OF HIGH-STRENGTH BOLTING
4. PRIOR TO WELDING, VERIFY THAT THE FOLLOWING ARE IN COMPLIANCE:						
A. APPROVED WELDER QUALIFICATION RECORDS AND CONTINUITY RECORDS	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
B. APPROVED WELDING PROCEDURE SPECIFICATIONS (WPS) AVAILABLE TO WELDERS AND WELDING INSPECTOR(S)	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1		X		
C. MANUFACTURER CERTIFICATIONS FOR WELDING CONSUMABLES AVAILABLE	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1		X		
D. MATERIAL IDENTIFICATION (TYPE/GRADE)	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			

E. WELDER IDENTIFICATION SYSTEM	1705.2.1	AISC 360: Sec. N5.4	X			
F. FIT-UP OF WELDS (INCLUDING JOINT GEOMETRY)	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X		NOTE 2	
G. CONFIGURATION AND FINISH OF ACCESS HOLES	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X		NOTE 2	
5. VERIFY DURING WELDING:						
A. CONTROL AND HANDLING OF WELDING CONSUMABLES	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
B. NO WELDING OVER CRACKED TACK WELDS	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X		NOTE 2	
C. ENVIRONMENTAL CONDITIONS	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
D. COMPLIANCE WITH WPS REQUIREMENTS	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X		NOTE 2	ALSO SEE REQUIREMENTS OF TABLE 3 FOR STRUCTURAL STEEL TEST REQUIREMENT
E. WELDING TECHNIQUES	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
F. PLACEMENT AND INSTALLATION OF STEEL HEADED STUD ANCHORS	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1		X		
6. AFTER WELDING, VERIFY THE FOLLOWING:						
A. WELDS CLEANED	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			

B. SIZE, LENGTH AND LOCATION OF WELDS	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X		NOTE 2	
C. WELDS MEET VISUAL ACCEPTANCE CRITERIA	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X		NOTE 2	
D. ARC STRIKES	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
E. K-AREA	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
F. BACKING REMOVED AND WELD TABS REMOVED (IF REQUIRED)	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
G. REPAIR ACTIVITIES	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
H. NO PROHIBITED WELDS HAVE BEEN ADDED WITHOUT THE APPROVAL OF THE EOR	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
I. NONDESTRUCTIVE WELDING INSPECTION	1705.2	AISC 360: Sec. N5.5 AWS D1.1	X		NOTE 2	
7. INSPECTION OF GALVANIZED STRUCTURAL STEEL MAIN MEMBERS FOR CRACKS SUBSEQUENT TO GALVANIZING	1705.2.1	AISC 360: Sec. N5.7	X			
8. INSPECTION OF STEEL FRAME JOINT DETAILS FOR COMPLIANCE:						
A. DETAILS SUCH AS BRACING AND STIFFENING	1705.2.1	AISC 360: Sec. N5.8	X			
B. MEMBER LOCATIONS	1705.2.1	AISC 360: Sec. N5.8	X			

C. APPLICATION OF JOINT DETAILS AT EACH CONNECTION	1705.2.1	AISC 360: Sec. N5.8	X			
ALUMINUM						
1. MATERIAL VERIFICATION OF ALUMINUM:						
A. IDENTIFICATION MARKINGS TO CONFORM TO ASTM STANDARDS SPECIFIED IN THE APPROVED CONSTRUCTION DOCUMENTS	1705.1.1 ITEM 2		X			
B. MANUFACTURERS' CERTIFIED MILL TEST REPORTS	1705.1.1 ITEM 2		X			
2. INSPECTION OF WELDING:						
A. NONDESTRUCTIVE INSPECTION	1705.1.1 ITEM 2	AWS D1.2	X		NOTE 2	

NOTES:

1. PERIODIC INSPECTION IS DEFINED AS INSPECTION BY THE SPECIAL INSPECTOR OF ALL MATERIALS AND SYSTEMS, IN SOME CASES PERFORMED DURING THEIR PLACEMENT AND IN ALL CASES PERFORMED UPON COMPLETION OF THEIR PLACEMENT. THE COMPLETION INSPECTION SHALL BE PERFORMED SO THAT WORK CAN BE CORRECTED PRIOR TO OTHER RELATED WORK PROCEEDING AND COVERING INSPECTED WORK.

2. VISUAL INSPECTION IS THE RESPONSIBILITY OF THE CONTRACTOR'S WELDING INSPECTOR(S) AND IS NOT CONSIDERED SPECIAL INSPECTION. CONTRACTOR MUST PROVIDE A QUALIFIED WELDING INSPECTOR TO OVERSEE CONTRACTOR'S WELDING OPERATIONS, AS REQUIRED BY REFERENCED WELDING CODES.

3. SPECIAL INSPECTOR TO OBSERVE ON AN INTERMITTENT BASIS SUFFICIENT TO CONFIRM THAT THE WORK HAS BEEN PERFORMED IN ACCORDANCE WITH THE APPLICABLE DOCUMENTS. OPERATIONS NEED NOT BE DELAYED PENDING THESE INSPECTIONS.

TABLE 3
TESTING FOR REQUIRED SPECIAL INSPECTION
REFER TO SPECIFICATION SECTION 01 45 33

MATERIAL	TYPE OR SCOPE	STANDARD	2021 IBC CODE REFERENCE	FREQUENCY	BY WHOM	COMMENTS
GEOTECHNICAL						
COMPACTED FILL	GRADATION	ASTM C117, C136	1705.6	SECTION 31 23 23, FILL AND BACKFILL	OWNER'S TESTING AGENCY	
COMPACTED FILL	COMPACTION	ASTM D1557	1705.6	SECTION 31 23 23, FILL AND BACKFILL	OWNER'S TESTING AGENCY	
COMPACTED FILL	DENSITY	ASTM D1557	1705.6	SECTION 31 23 23, FILL AND BACKFILL	OWNER'S TESTING AGENCY	
PREPARED SUBGRADE	DENSITY	ASTM D1557	1705.6	SECTION 31 23 13, SUBGRADE PREPARATION	OWNER'S TESTING AGENCY	
CONCRETE						
CONCRETE	STRENGTH	ASTM C39	1705.3, 1904.1	ONCE EACH DAY, BUT NOT LESS THAN ONE SAMPLE FOR EACH 150 CUBIC YARDS OR 5,000 SFT OF WALLS OR SLABS PLACED	OWNER'S TESTING AGENCY	
SHOTCRETE	STRENGTH	ASTM C42	1705.3, 1908.1	ONCE EACH SHIFT, BUT NOT LESS THAN ONE SAMPLE FOR EACH 50 CUBIC YARDS PLACED	OWNER'S TESTING AGENCY	
CONCRETE	SLUMP	ASTM C143, C94	1705.3, 1904.1	ONE SAMPLE PER STRENGTH TEST	OWNER'S TESTING AGENCY	

CONCRETE	AIR CONTENT	ASTM C231, C94	1705.3, 1904.1	ONE SAMPLE PER STRENGTH TEST	OWNER'S TESTING AGENCY	
CONCRETE	TEMPERATURE	ASTM C1064	1705.3, 1904.1	ONE SAMPLE PER STRENGTH TEST	OWNER'S TESTING AGENCY	
STEEL						
STEEL STUD WELDING	PRE-PRODUCTION TESTING	AWS D1.1 Sec. 9.7.1	1705.2	PRIOR TO CONSTRUCTION FOR EACH SIZE AND TYPE AND FIRST 2 STUDS EACH SHIFT	CONTRACTOR'S WELDING INSPECTOR	
HIGH-STRENGTH BOLTING	PRE-INSTALLATION VERIFICATION TESTING OF PRETENSIONED BOLTS	RCSC SPECIFICATION FOR STRUCTURAL JOINTS USING HIGH STRENGTH BOLTS, Sec. 7	1705.2	3 FASTENER ASSEMBLIES OF EACH COMBINATION OF DIAMETER, LENGTH, GRADE AND LOT	OWNER'S TESTING AGENCY	
STRUCTURAL STEEL	ULTRASONIC OR RADIOGRAPHIC NONDESTRUCTIVE TESTING	AWS D1.1	1705.2	SECTION 05 05 23, WELDING	OWNER'S TESTING AGENCY	PERFORM RT OR UT ON GROOVE WELDS
REINFORCING STEEL	MAGNETIC PARTICLE NONDESTRUCTIVE TESTING	AWS D1.4	1705.3	SECTION 05 05 23, WELDING	OWNER'S TESTING AGENCY	PERFORM ON FILLET WELDS AND PARTIAL JOINT PENETRATION WELDS

TABLE 4

REQUIRED SPECIAL INSPECTION FOR SEISMIC RESISTANCE FOR STRUCTURAL SYSTEMS
REFER TO TABLE 2 FOR STANDARD STRUCTURAL SPECIAL INSPECTION REQUIREMENTS
REFER TO SPECIFICATION SECTION 01 45 33

The Seismic Design Category (SDC) for this Project is D.

SYSTEM	INSPECTION REQUIRED FOR FOLLOWING SEISMIC DESIGN CATEGORIES	2021 IBC CODE REFERENCE	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
NONE REQUIRED FOR THIS PROJECT						

TABLE 5

REQUIRED SPECIAL INSPECTION FOR WIND RESISTANCE FOR STRUCTURAL SYSTEMS
REFER TO SPECIFICATION SECTION 01 45 33

The Basic Wind Speed (3-second-gust) for this Project is 110 mph.

The Wind Exposure is Category C.

SYSTEM	2021 IBC CODE REFERENCE	STANDARD OR CODE	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS
NONE REQUIRED FOR THIS PROJECT					

TABLE 6

TESTING FOR SEISMIC RESISTANCE
REFER TO SPECIFICATION SECTION 01 45 33

MATERIAL	TYPE OR SCOPE	STANDARD	2021 IBC CODE REFERENCE	FREQUENCY	BY WHOM	COMMENTS
NONE REQUIRED FOR THIS PROJECT						

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of Nurserymen (AAN): American Standards for Nursery Stock.
2. Federal Emergency Management Agency (FEMA).
3. National Fire Prevention Association (NFPA): 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.
4. Telecommunications Industry Association (TIA); Electronic Industries Alliance (EIA): 568B, Commercial Building Telecommunications Cabling Standard.
5. U.S. Department of Agriculture (USDA): Urban Hydrology for Small Watersheds.
6. U.S. Weather Bureau: Rainfall-Frequency Atlas of the U.S. for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years.

1.02 SUBMITTALS

A. Informational Submittals:

1. Copies of permits and approvals for construction as required by Laws and Regulations and governing agencies, and as identified in Section 01 51 00, Permits.
2. Copies of all draft and final traffic control plans, supplements, and permits must be provided to JVWCD, and City of South Jordan.
3. Temporary Control Submittals:
    a. Dust control plan.
    b. Plan for disposal of waste materials and intended haul routes.

1.03 MOBILIZATION

A. Mobilization shall include, but not be limited to, these principal items:

1. Obtaining required permits.
2. Moving Contractor’s field office and equipment required for first month operations onto Site.
3. Installing temporary construction power, wiring, and lighting facilities.
4. Providing onsite communication facilities, including telephones.

5. Providing onsite sanitary facilities and potable water facilities as specified and as required by Laws and Regulations, and governing agencies.
6. Arranging for and erection of Contractor's work and storage yard.
7. Posting OSHA required notices and establishing safety programs and procedures.
8. Having Contractor's superintendent at Site full time.

1.04 PROTECTION OF WORK AND PROPERTY

A. Comply with Owner's safety rules while on Owner's property.

B. Keep Owner informed of serious onsite accidents and related claims.

C. Use of Explosives: No blasting or use of explosives will be allowed onsite.

1.05 VEHICULAR TRAFFIC

A. Traffic Control Plan: As specified by the City and other required permits.

PART 2 PRODUCTS

2.01 ENGINEER'S FIELD OFFICES

A. Furnish equipment specified for use of Engineer and its representatives.

B. Ownership of equipment furnished under this article will remain, unless otherwise specified, that of Contractor.

C. Equipment furnished shall be new or like new in appearance and function.

D. Minimum Features:

1. 110-volt lighting and wall plugs.
2. Fluorescent ceiling lights.
3. Electric heating and self-contained air conditioning unit, properly sized for Project locale and conditions. Provide ample electric power to operate installed systems.
4. Railed stairways, and landings at entrance.
5. Exterior Door(s):
   a. Number: Two.
   b. Type: Solid core.
   c. Lock(s): Cylindrical.
6. Number of Windows: Two.
7. Minimum Interior Height: 8 feet.

E. Floor Space: Minimum 255 square feet.

F. Rooms: Two, with minimum private office floor space of 80 square feet, and remainder configured for open meeting or storage space.

G. Plan table; plan rack; one double desk(s) with desk surface located 29 inches from floor; two 2-drawer, steel file cabinets; and overhead shelf(s).

H. Trailer Type Mobile Structure: One.

I. Office Equipment—General:

1. Bottled water service.
2. Refrigerator.
3. Clean microwave.
4. Paper cup dispenser with cups.
5. Paper towels available.
6. Desk: One, steel, 30 inches by 60 inches with desk surface located 29 inches from floor.
7. Swivel desk chair with five roller type legs.
8. Table for meetings as least 36 inches by 72 inches.
9. Folding chairs.
10. Wastepaper basket.
11. First-aid kit.
12. Tri-class (ABC), dry chemical fire extinguisher, 10-pound.

J. Computer Hardware:

1. High speed LTE internet modem.
2. Color printer for 11-inch by 17-inch sized paper with scanning capabilities.
3. Standard keyboard and mouse.
4. Power supply surge protector with a minimum of five receptacles rated at 15 amps minimum.
5. Maintenance service agreements for all hardware for duration of Contract.

2.02 PROJECT SIGN

A. Provide and maintain one, 8-foot wide by 4-foot high sign constructed of 3/4-inch exterior high density overlaid plywood. Sign shall bear name of Project, Owner, Contractor, Engineer, and other participating agencies. Lettering shall be blue applied on a white background by an experienced sign manufacturer. Paint or sign finish shall be exterior type construction capable of withstanding hard weather conditions typical for Project location. Information to be included will be provided by Owner.

PART 3 EXECUTION

3.01 ENGINEER'S FIELD OFFICE

A. Make available for Engineer's use within 1 week of when the tank site property has become available, and to remain on Site for minimum of 30 days after final acceptance of the Work.

B. Locate where approved by Engineer; level, block, tie down, skirt, provide stairways, and relocate when necessary and approved. Construct on proper foundations, and provide proper surface drainage and connections for utility services.

C. Provide gravel or crushed rock base, minimum depth of 4 inches, at each entrance.

D. Raise grade under field office, as necessary, to elevation adequate to avoid flooding.

E. Provide sanitary facilities in compliance with state and local health authorities.

F. Exterior Door Keys: Furnish two set(s) of keys.

G. Computer: Provide required connecting cables and plugs.

H. Telecommunications:

1. Provide internet connection with minimum of five live portable computer (PC) ports.
2. Provide appropriate jacks, wiring, and equipment required for a complete telecommunications system.
3. Arrange and provide for telecommunication service for use during construction. Pay costs of installation, maintenance, and monthly service of internet connection.

I. Maintain in good repair and appearance, and provide weekly cleaning service and replenishment, as required, of paper towels, paper cups, hand soap, toilet paper, first-aid kit supplies, and bottled water.

J. Replenish, as needed, copy paper and toner.

3.02 TEMPORARY UTILITIES

A. Power: No electric power is available at Site. Make arrangements to obtain and pay for electrical power used until final payment and acceptance by Owner, unless otherwise recommended by Engineer at Substantial Completion.

B. Lighting: Provide temporary lighting to meet applicable safety requirements to allow erection, application, or installation of materials and equipment, and observation or inspection of the Work.

C. Heating, Cooling, and Ventilating:

1. Provide as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for installation of materials, and to protect materials, equipment, and finishes from damage due to temperature or humidity. Costs for temporary heat shall be borne by Contractor.
2. Provide adequate forced air ventilation of enclosed areas to cure installed materials, to dispense humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
3. Pay all costs of installation, maintenance, operation, removal, and fuel consumed.
4. Provide portable unit heaters, complete with controls, oil- or gas-fired, and suitably vented to outside as required for protection of health and property.
5. If permanent natural gas piping is used for temporary heating units, do not modify or reroute gas piping without approval of utility company. Provide separate gas metering as required by utility.

D. Water:

1. Construction and/or potable water is available at the Site. Make arrangements with the District to provide water required for construction purposes and for drinking by construction personnel during construction. Contractor will be responsible to make the necessary connections and pay for metered water.
2. Provide and bear costs of necessary water required for testing equipment, tanks or basins, and piping prior to Substantial Completion, unless otherwise specifically stated in Specifications for equipment, systems, or facilities to be tested.
3. Provide a means to prevent water used for testing from flowing back into source pipeline.

E. Sanitary and Personnel Facilities: Provide and maintain facilities for Contractor's employees, subcontractors, and all other onsite employers' employees. Service, clean, and maintain facilities and enclosures.

F. Fire Protection: Furnish and maintain on Site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable parts of NFPA 241.

3.03 PROTECTION OF WORK AND PROPERTY

A. General:

1. Perform Work within right-of-way and easements in a systematic manner that minimizes inconvenience to property owners and the public.
2. No residence or business shall be cut off from vehicular traffic for a period exceeding 4 hours, unless special arrangements have been made.
3. Maintain in continuous service all existing oil and gas pipelines, underground power, telephone or communication cable, water mains, irrigation lines, sewers, poles and overhead power, and all other utilities encountered along line of the Work, unless other arrangements satisfactory to owners of said utilities have been made.
4. Where completion of the Work requires temporary or permanent removal or relocation of existing utility, coordinate all activities with owner of said utility and perform all work to their satisfaction.
5. Protect, shore, brace, support, and maintain underground pipes, conduits, drains, and other underground utility construction uncovered or otherwise affected by construction operations.
6. Keep fire hydrants and water control valves free from obstruction and available for use at all times.
7. In areas where Contractor's operations are adjacent to or near a utility, such as gas, telephone, television, electric power, water, sewer, or irrigation system, and such operations may cause damage or inconvenience, suspend operations until arrangements necessary for protection have been made by Contractor.
8. Notify property owners and utility offices that may be affected by construction operation at least 2 days in advance: Before exposing a utility, obtain utility owner's permission. Should service of utility be interrupted due to Contractor's operation, notify proper authority immediately. Cooperate with said authority in restoring service as promptly as possible and bear costs incurred.

9. Do not impair operation of existing sewer system. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering sewers, pump stations, or other sewer structures.
10. Maintain original Site drainage wherever possible.

B. Site Security:

1. Erect a temporary security fence at locations shown on Drawings or specified in individual specification sections for protection of the construction site and security from the public.
2. Provide and maintain additional temporary security fences as necessary to protect the Work and Contractor-furnished products not yet installed.

C. Barricades and Lights:

1. Provide as required by the City and in sufficient quantity to safeguard public and the Work.
2. Provide as necessary to prevent unauthorized entry to construction areas and affected roads, streets, and alleyways, inside and outside of fenced area, and as required to ensure public safety and the safety of Contractor's employees, other employer's employees, and others who may be affected by the Work.
3. Provide to protect existing facilities and adjacent properties from potential damage.
4. Locate to enable access by facility operators and property owners.
5. Protect streets, roads, highways, and other public thoroughfares that are closed to traffic by effective barricades with acceptable warning signs.
6. Locate barricades at the nearest intersecting public thoroughfare on each side of the blocked section.
7. Illuminate barricades and obstructions with warning lights from sunset to sunrise.

D. Signs and Equipment:

1. Conform to requirements of the City.
2. Provide at obstructions, such as material piles and equipment.
3. Use to alert general public of construction hazards, which would include surface irregularities, unramped walkways, grade changes, and trenches or excavations in roadways and in other public access areas.

E. Trees and Plantings:

1. Protect from damage and preserve trees, shrubs, and other plants outside limits of the Work and within limits of the Work, which are designated on Drawings to remain undisturbed.
    a. Employ hand excavation as necessary to prevent tree injury.
    b. Do not stockpile materials or permit traffic within drip lines of trees.
    c. Provide and maintain temporary barricades around trees that are to be protected.
    d. Water vegetation as necessary to maintain health.
    e. Cover temporarily exposed roots with wet burlap, and keep burlap moist until soil is replaced around roots.
    f. No trees, except those specifically shown on Drawings to be removed, shall be removed without written approval of Engineer.
    g. Dispose of removed trees in a legal manner off the Site.
2. Balling and burlapping of trees indicated for replacement shall conform to recommended specifications set forth in the American Standards for Nursery Stock, published by American Nursery and Landscape Association. All balls shall be firm and intact and made-balls will not be accepted. Handle ball and burlap trees by ball and not by top.
3. In event of damage to bark, trunks, limbs, or roots of plants that are not designated for removal, treat damage by corrective pruning, bark tracing, application of a heavy coating of tree paint, and other accepted horticultural and tree surgery practices.
4. Replace each plant that dies as a result of construction activities.

F. Existing Structures:

1. Where Contractor contemplates removal of small structures such as mailboxes, signposts, and culverts that interfere with Contractor's operations, obtain approval of property owner and Resident Project Representative.
2. Move mailboxes to temporary locations accessible to postal service.
3. Replace items removed in their original location and a condition equal to or better than original.

G. Waterways: Keep ditches, culverts, and natural drainages continuously free of construction materials and debris. Protect existing storm inlets and follow requirements of the approved SWPPP as identified in Section 01 51 00, Permits.

H. Dewatering: Construct, maintain, and operate cofferdams, channels, flume drains, sumps, pumps, or other temporary diversion and protection works. Furnish materials required, install, maintain, and operate necessary pumping and other equipment for the environmentally safe removal and disposal of water from the various parts of the Work. Maintain foundations and parts of the Work free from water.

I. Archaeological Finds:

1. General: Should finds of an archaeological or paleontological nature be made within the limits of the Site, immediately notify Owner and Engineer and proceed in accordance with the General Conditions. Continue the Work in other areas without interruption.
2. Archaeological Finds: Evidence of human occupation or use of an area within the contract limits prior to the Year 1840. Evidence may consist of skeletons, stone, or other utensils, or evidence of habitations or structures.
3. Paleontological Finds: Evidence of prehistoric plant or animal life, such as skeletons, bones, fossils, or casts and other indications such as pictographs.
4. Owner may order the Work stopped in other areas if, in Owner’s opinion, the find is more extensive than may appear from uncovered material.
5. Protection of Finds:
    a. Cover, fence, or otherwise protect finds until notice to resume the Work is given.
    b. Cover finds with plastic film held in place by earth, rocks, or other weights placed outside the find. Should additional backfilling be necessary for safety or to prevent caving, place backfill material loosely over the plastic film.
    c. Sheet or shore as necessary to protect excavations underway. Place temporary fence to prevent unauthorized access.
    d. Dewater finds made below water table as necessary to protect construction Work underway. Divert groundwater or surface runoff away from find by ditching or other acceptable means.

6. Removal of Finds:
    a. All finds are property of Owner. Do not remove or disturb finds without Owner's written authorization.
    b. Should Owner elect to have a find removed, provide equipment, labor, and material to permit safe removal of find without damage. Provide transportation for delivery to individuals, institutions, or other places as Owner may find desirable, expedient, or required by law.

J. Endangered and Threatened Species:

1. Take precautions necessary and prudent to protect native endangered and threatened flora and fauna.
2. Notify Engineer of construction activities that might threaten endangered and threatened species or their habitats.
3. Engineer will mark areas known as habitats of endangered and threatened species prior to commencement of onsite activities.
4. Additional areas will be marked by Engineer as other habitats of endangered and threatened species become known during construction.

3.04 TEMPORARY CONTROLS

A. Air Pollution Control:

1. Minimize air pollution from construction operations.
2. Burning of waste materials, rubbish, or other debris will not be permitted on or adjacent to Site.
3. Conduct operations of dumping rock and of carrying rock away in trucks to cause a minimum of dust. Give unpaved streets, roads, detours, or haul roads used in construction area a dust-preventive treatment or periodically water to prevent dust. Strictly adhere to applicable environmental regulations for dust prevention.
4. Provide and maintain temporary dust-tight partitions, bulkheads, or other protective devices during construction to permit normal operation of existing facilities. Construct partitions of plywood, insulating board, plastic sheets, or similar material. Construct partitions in such a manner that dust and dirt from demolition and cutting will not enter other parts of existing building or facilities. Remove temporary partitions as soon as need no longer exists.

B. Noise Control:

1. Provide acoustical barriers so noise emanating from tools or equipment will not exceed legal noise levels.
2. Noise Control Plan: Propose plan to mitigate construction noise and to comply with noise control ordinances, including method of construction, equipment to be used, and acoustical treatments.

C. Water Pollution Control:

1. Divert sanitary sewage and nonstorm waste flow interfering with construction and requiring diversion to sanitary sewers. Do not cause or permit action to occur which would cause an overflow to existing waterway.
2. Comply with Section 01 51 00, Permits, for stormwater flow and surface runoff.
3. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm or sanitary drains. Disposal of wastes into streams or waterways is prohibited. Provide acceptable containers for collection and disposal of waste materials, debris, and rubbish.

D. Erosion, Sediment, and Flood Control: Comply with Section 01 51 00, Permits.

3.05 STORAGE YARDS AND BUILDINGS

A. Coordinate requirements with Section 01 61 00, Common Product Requirements.

B. Temporary Storage Yards: Construct temporary storage yards for storage of products that are not subject to damage by weather conditions.

C. Temporary Storage Buildings:

1. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials stored.
2. Arrange or partition to provide security of contents and ready access for inspection and inventory.
3. Store combustible materials (paints, solvents, fuels) in a well-ventilated and remote building meeting safety standards.

3.06 ACCESS ROADS

A. Construct access roads as shown and within easements, rights-of-way, or Project limits.

B. Maintain drainage ways. Install and maintain culverts to allow water to flow beneath access roads. Provide corrosion-resistant culvert pipe of adequate strength to resist construction loads.

C. Provide gravel, crushed rock, or other stabilization material to permit access by all motor vehicles at all times.

D. Maintain road grade and crown to eliminate potholes, rutting, and other irregularities that restrict access.

E. Coordinate with Engineer detours and other operations affecting traffic and access. Provide at least 72 hours' notice to Engineer of operations that will alter access to the Site.

F. Where access road crosses existing fences, install and maintain gates. Gates and gate posts shall conform to those as specified in Section 32 31 13, Chain Link Fences and Gates.

G. Upon completion of construction, restore ground surface disturbed by access road construction to original grade. Replace damaged or broken culverts with new culvert pipe of same diameter and material.

3.07 PARKING AREAS

A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Owner's operations, or construction operations.

B. Provide parking facilities for personnel working on the Project. No employee or equipment parking will be permitted on Owner's existing property.

3.08 VEHICULAR TRAFFIC

A. Comply with Laws and Regulations regarding closing or restricting use of public streets or highways. No public or private road shall be closed, except by written permission of proper authority. Assure the least possible obstruction to traffic and normal commercial pursuits.

3.09 CLEANING DURING CONSTRUCTION

A. In accordance with General Conditions, as may be specified in other Specification sections, and as required herein.

B. Provide approved containers for collection and disposal of waste materials, debris, and rubbish. At least at weekly intervals, dispose of such waste materials, debris, and rubbish offsite.

C. At least weekly, brush sweep entry drive, roadways, and all other streets and walkways affected by the Work and where adjacent to the Work.

END OF SECTION

SECTION 01 51 00
PERMITS

PART 1 GENERAL

1.01 DESCRIPTION

A. This section lists the known required permits and known requirements of these permits for the Work. The Contractor should note that the list is not necessarily complete and additional permits may be required to execute the Work.

1.02 GENERAL

A. During the Bid period, the Contractor shall review all permits and the requirements of all permits and shall structure the Bid to meet the requirements of the listed permits. Include in the Bid the cost of obtaining all necessary permits, including application fees, bonds, and other costs, and the costs of complying with the conditions of all permits, including the conditions of permits obtained by the Owner. Any permit fees listed in this section are estimates and for Contractor's information only. The Contractor shall verify and pay all actual fees.

B. The Contractor shall obtain all permits required for the execution of the Work that have not been obtained by the Owner, as indicated in this section. Submit copies of all Contractor-obtained permits to the Project Representative and keep a copy of each onsite. Comply with the conditions of all Owner-obtained and Contractor-obtained permits.

C. Completeness of the list of Contractor-obtained permits is not guaranteed. The absence of information does not relieve the Contractor of responsibility for determining and verifying the extent of permits required, of obtaining such permits, and complying with the conditions of each permit.

1.03 SUMMARY OF PERMITS OBTAINED BY OWNER

A. The following permits have been, or will be, obtained by the Owner for this Project. Copies of the permits and their requirements are available for review at the Owner's office. No additional compensation or Contract Extensions shall be granted to Contractor because of delays by Owner to obtain any permit, unless the Contractor is unable to proceed and complete the Work because of such delays as demonstrated by the Contractor's approved Project schedule. See Section 01 31 13, Project Coordination, for other agency and contact information.

1. Utah Department of Environmental Quality, Division of Drinking Water:
    a. Project Notification and Construction Approval: This approval covers the construction of the Project as shown on Drawings.

b. Operating Permit: This permit allows the Owner to operate the new facilities.

2. Utah Division of Water Rights: Stream Alteration Permit.
3. Salt Lake County: Flood Control Permit.
4. South Jordan City: Site Plan Application and Approval.

1.04 SUMMARY OF PERMITS TO BE OBTAINED BY CONTRACTOR

A. The following permits shall be obtained by Contractor. Completeness of this list is not guaranteed. Contractor is required to obtain all necessary permits. See Section 01 31 13, Project Coordination, for other agency and contact information.

1. Utah Occupational Safety and Health Administration:
   a. Construction Permit: Covers worker safety and health for all project features.
2. South Jordan City:
   a. Land Disturbance Permit: This permit covers construction of the pipeline in the South Jordan City right-of-way.
      1) Agency and Contact Person:
         a) Agency: South Jordan City
            Name: Shane Greenwood
            Telephone: (801) 254-3742
   b. Building Permit: This permit is required for construction for multiple buildings onsite.
3. Utah Department of Environmental Quality, Division of Air Quality:
   a. UPDES Fugitive Dust Control Plan Permit: This permit covers the fugitive dust control plan associated with construction activities. Contract shall develop and comply with the fugitive dust control plan as required by the UDEQ (A1.9) and meet the requirements to be compliant with the Utah Division of Air Quality Fugitive Dust Control Requirements for Non-Attainment Areas Stationary Source Compliance Rules (R308-309).
      1) Agency and Contact Information:
         a) Agency: Utah Department of Environmental Quality, Division of Air Quality
            195 North 1950 West
            P.O. Box 144820
            Salt Lake City, Utah 84114-4820
            Telephone: (801) 536-4000
4. Utah Department of Environmental Quality, Division of Water Quality:
   a. UPDES General Permit for Construction Dewatering/Hydrostatic Testing of Pipelines: Covers discharge waters associated with dewatering operations and hydrostatic testing of pipelines (see following information).

b. Notification of Chlorinated Water Discharge: This notification provides 30 days' notice prior to disinfection of pipeline and discharge of pipeline and discharge of chlorinated water.
   1) Agency and Contact Person:
      a) Agency: Utah Department of Environmental Quality, Division of Drinking Water
      Name: Kim Shelley
      195 North 1950 West
      P.O. Box 144870
      Salt Lake City, Utah 84114-4870
      Telephone: (801) 536-4385
      E-mail: kshelley@utah.gov

c. UPDES Construction Stormwater Permit: Covers stormwater discharges associated with construction activities (see following information).
   1) Discharge of wastewater or other pollutants, as a result of construction activities, into navigable waters in Utah, requires a 402 Permit or UPDES permit defined under Section 402 of the Clean Water Act, Public Law 92-500, as amended by Public Law 95-217. The UPDES permit process is administered by UDWQ, 288 North 1460 West, Salt Lake City, Utah 84116, (801) 538-6146. Permit conditions include:
      a) General: Submit a Notice of Intent to comply with the Federal Clean Water Act, Section 402 UPDES General Permit during the construction of the Point of the Mountain Aqueduct Project. The Contractor shall complete any project specific permit applications and other requirements specified by UDWQ and obtain any project specific UPDES permits. The UDWQ has indicated that a project specific UPDES stormwater permit may now be obtained via their internet web site. The UDWQ has indicated that a project specific UPDES dewatering/hydrostatic testing permit must be obtained through their office. No construction may be performed until the project specific UPDES permits are obtained. The Contractor shall abide by the conditions and standards required by the UPDES General Permits and any UPDES project specific permits during all phases of construction.
         (1) Prepare a Stormwater Pollution Prevention Plan (SWPPP) as required by the permit and submit to Project Representative for approval prior to submitting Notice of Intent and prior to commencing earth disturbing activities. Comply

with all terms and conditions to obtain and maintain this general permit.

(2) Provide all monitoring and water treatment, if necessary, to achieve compliance with applicable Water Quality Standards. Provide the record keeping required by the general permit associated with construction activity.

b) Turbidity and pH Control: Turbid wastewater resulting from aggregate processing, excavation, dewatering, and other construction activities shall be treated prior to discharge into any watercourse by the use of methods approved by the Project Representative and UDWQ.

(1) Construction Activities: Conduct excavation, road construction, and all other construction activities in a manner to prevent muddy water and eroded materials from entering Midas Creek or any tributary or any other watercourse by the construction of intercepting ditches, barriers, settling ponds, or other approved means. Provide sumps, pumps, and associated facilities, as described in the Water Quality Management Plan requirement described hereafter.

(2) The Contractor’s methods of dewatering and stockpiling earth shall include preventive measures to control silting and erosion and to intercept any runoff originating in construction areas.

c) Construction Wastewater:

(1) Construction wastewater resulting from materials processing, placement of concrete, dewatering, excavations, drainage at the excavated material disposal and storage sites, drainage water from constructing water control equipment, waste sludge, the cleaning of heavy equipment used in construction, and other construction operations shall be conveyed to the treatment facility prior to the discharge to watercourse or approved wastewater facility. Discharge of wastewater to any receiving waters shall be treated by use of the proposed treatment facility described in this document. The Contractor may propose an alternative method of wastewater treatment. Alternative methods must be approved by Owner and UDWQ and shall be fully described in the Contractor’s Water Quality Management Plan. All discharges shall be in

compliance with the Federal Clean Water Act, Section 402 UPDES General Permit.

(2) Flows from the dewatering operation may require holding ponds to provide the necessary detention period. If construction wastewater can be contained in ponds or other holding facilities and allowed to seep into the ground or evaporate, then no treatment shall be necessary.

(3) The pond dikes shall be constructed of impervious materials and adequately compacted with 2 feet of freeboard to provide protection from accidental discharges. The location, size, and method of construction of ponds shall be submitted to the Project Representative and the UDWQ as part of the Water Quality Management Plan. Construction of the ponds shall not commence until receipt of approval.

(4) The decision to bypass water treatment facilities shall be subject to approval by the Project Representative and UDWQ as provided in the UPDES permit.

(5) All chemicals used for treating wastewater must be approved by the EPA for use in potable water. Also, the types and amounts of chemicals used in any approved method for the control of turbidity or pH shall not cause the effluent to be toxic or in any way harmful to terrestrial wildlife or aquatic life.

(6) Skim and properly dispose of any oil or other petroleum product on any settling pond when an oil film on the surface of any pond covers more than one-third of the surface area of the pond. When sludge or settled materials in ponds accumulate so as to impair the effectiveness of the facilities, the materials shall be removed and transported to a waste disposal area.

(7) Satisfactorily operate any wastewater treatment facilities such that they provide effluent that meets required UPDES permit limitations. The approval of the Contractor’s proposal by the Project Representative shall not be construed to relieve the Contractor from this responsibility. Repair at his expense, any damage to or failure of the facilities and equipment caused by floods or storm runoff.

d) Compliance with Other Permits: The UPDES permit requires compliance with other related permits discussed in this section.

e) Spill Prevention Control and Countermeasure (SPCC) Plan: Where the location of a construction site is such that oil from an accidental spillage could reasonably be expected to enter into or navigable waters of the United States or adjoining shorelines and the aggregate storage of oil above ground at the site is over 1,320 gallons or a single container has a capacity in excess of 660 gallons, or the aggregate storage of oil underground is in excess of 42,000 gallons, prepare and implement a SPCC plan in accordance with 40 CFR, Part 112, as required by Public Law 92-500 as amended. The SPCC plan shall include as a minimum the following:

(1) Agency Notification Requirements: A listing of persons and/or offices to be notified immediately following an oil spill together with the appropriate telephone numbers. The following agencies and/or individuals shall be included in that list:

(a) Utah Department of Environmental Quality
Division of Environmental Response and Remediation
195 North 1950 West
Salt Lake City, Utah
Telephone: (801) 536-4100
24-hour Emergency Phone: (801) 536-4123

(b) Environmental Protection Agency
Attn: Water Management Division
999 18th Street, Suite 500
Denver, Colorado 80202-2466
24-hour Emergency Phone: (800) 424-8802
**NOTE: Failure to notify EPA of an accidental spill within 24 hours of its occurrence may result in the levying of a fine against the responsible party.

(c) U.S. Fish and Wildlife Service
2369 West Orton Circle, Suite 50
West Valley City, Utah 84119-7603
Telephone: (801) 975-3330
**After hours contact National Response Center: (800) 424-8802.

f) Spill Prevention Measures: Spill prevention measures shall include:

(1) A site plan indicating storage areas, refueling areas, and other areas where oil and other petroleum products and other hazardous liquids would be used or handled. The site plan shall also show the distance to all watercourses (perennial or intermittent) or other bodies of water where oil and other hazardous liquids could be directly or indirectly spilled, and oil, fuel, and other hazardous liquid storage areas and refueling areas shall not be located within the 200-foot buffer zone of any live or dry watercourse. No on-site storage of petroleum products (gasoline, oils, hydraulic fluid, lubricants, etc.) shall be stored within the area of construction or materials marshaling areas. Use a vehicle designed for refueling and lubricating construction equipment. During refueling, lubricating, and other maintenance, construction vehicles and equipment shall be moved at least 200 feet from the edge of any live or dry watercourse.

(2) The plan shall include appropriate containment structures to prevent hazardous liquids from reaching any watercourse. At a minimum, the preventive system shall include:

(a) No oil and oil storage areas and areas for refueling equipment shall be located in construction and materials storage areas.

(b) Refueling and lubricating of equipment shall be performed by a vehicle designed for this activity.

(3) The plan shall include a complete discussion of conformance with the following guidelines:

(a) Job-site drainage system shall flow into ponds, lagoons, or other catchment basins that are not subject to periodic flooding and engineered to prevent oil and other hazardous liquids from reaching any watercourse or adjacent shorelines in the event of equipment failures or human error.

(b) All oil or fuel leaks from equipment shall be promptly cleaned up.

(4) Contingency and Countermeasures: In the event of an oil spill or spill of other hazardous liquid into a watercourse, other body of water, or adjacent shorelines of watercourses, contingency and countermeasures shall include as a minimum the following:
   (a) A commitment of manpower, materials, and equipment to expeditiously control the spill and removal of spilled material.
   (b) A commitment to place all available manpower, materials, and equipment into immediate use to cleanup and restore the affected watercourses and adjoining shorelines.
   (c) A sampling-monitoring program to document the effectiveness of the spill cleanup program. Proper sampling equipment, sampling procedures, and name of certified laboratory analyzing the samples shall be included.

(5) Sanitation and Potable Water Requirements: Provide and maintain portable toilets for workers. No discharge of human wastewater shall be allowed. Provide potable water at the main staging area.

(6) Prepare a Pollution Prevention Plan as required by the permit. Comply with all terms and conditions to obtain and maintain this general permit.

(7) Provide all monitoring and water treatment, if necessary, to achieve compliance with applicable Water Quality Standards. Provide the record keeping required by the general permit associated with construction activity.

g) Water Quality Management Plan: Prepare a Water Quality Management Plan as required which shall include, but not be limited to, the following:

(1) Identification of a Pollution Control and Water Quality Coordinator responsible for implementing the control measures in the management plan.

(2) Treatment of Nonpoint Discharges:
   (a) A list of materials, machinery, and manpower available for erosion control. Erosion control materials may include bales of straw, dikes, silt fencing, riprap, gabions, culverts, pipe, sandbags, gravel, plastic, and flexible downdrains. Quantities of material and equipment shall be included.
   (b) Site-Specific Control Plan for:
      - Contractor's camps, yards, and all work areas.
      - Equipment washing areas.
      - Fueling.
      - Excavated material storage areas and waste disposal areas.

(3) Treatment of Point Discharges:
   (a) Methods for treatment of water used and/or encountered during construction.
   (b) Proposed Plan for Water Treatment Facilities Including:
      - Location, capacity, size, and method of constructing ponds and water conveying system.
      - Complete design and construction details of the water treatment plant, if proposed.
      - Arrangement for the turbidity and pH control structures.
      - Method for conveying untreated water to the control structures or treatment plant and water from these facilities to the authorized discharge point.
      - Method of storing and disposing of sludge, settling pond residue, or backwater residue accumulation.
      - Description of chemicals to be used in the water treatment facilities.
      - Methods of handling and disposing of oil and other petroleum products, chemicals, and similar industrial wastes collected within the treatment facility.
      - Other salient features.

(c) Monitoring Program: A complete description of a daily and weekly water quality, monitoring program developed to meet the UPDES permit requirements. The program shall follow the outline and requirements in item “i” that follows.

h) Submittal of Water Quality Management Plan:
   (1) If desired, the Contractor within 30 calendar days after the award of the contract can submit, for Owner approval, six copies of an alternative Water Quality Management Plan. If an alternative plan is not submitted within this period, implement the plan described above.
   (2) Approval of Contractor’s plan shall not relieve the Contractor of responsibility for designing, constructing, operating, and maintaining a turbidity and pH control plan in a safe and systematic manner and for repairing at his expense any damage to or failure of the turbidity and pH control structure and equipment caused by floods or storm runoff.
   (3) Obtain Utah State Division of Health approval prior to installing any sanitary or industrial pollution control facilities, including the turbidity control facilities. Submit plans for approval to the Utah Division of Health, Attn: Mr. Don A. Ostler, 288 North 1460 West, P.O. Box 16690, Salt Lake City, Utah 84116-0690. A copy of the approval shall be sent to the Engineer. Additional information on State Health Requirements can be obtained by calling (801) 538-6146.

i) Water Quality Management Plan - Water Quality Sampling and Testing:
   (1) The Contractor shall perform water quality sampling and testing as are necessary to maintain proper control of TSS, turbidity, oil and grease, pH, temperature, and oil sheen in all construction wastewater discharge operations and ensure compliance with the UPDES permit.

(2) The sampling and testing of water shall be accomplished according to standard procedures described in the latest edition of the EPA publication "Methods for Chemical Analysis of Water and Wastes." As a minimum, the program shall consist of measuring the pH, turbidity, and water temperature of the effluent from the water treatment facilities twice each working day. The location for monitoring the effluent shall be approved by the Project Representative.

(3) All water sampling data shall include the date, time of day, name of person(s) taking the sample, and recording measurements. A copy of the results of all laboratory analysis for oil and grease shall be submitted to the Project Representative immediately upon receipt by the Contractor. A copy of the Quarterly Discharge Monitoring Report submitted by the Contractor to the Utah Division of Environmental Health as a requirement under the 402 Permit shall be sent to the Project Representative at the same time. Access to all water quality monitoring sites shall be maintained by the Contractor. The release of treated effluent to the stream shall be subject to the approval of the Project Representative.

(4) Any sampling, testing, and monitoring of stream water that may be done by the Owner shall in no way relieve the Contractor of the responsibility for doing such monitoring as is necessary for controlling of his operations to prevent violation of specific water quality standards.

2) Agency and Contact Person:

a) Utah Department of Environmental Quality (UDEQ),
Division of Water Quality (DWQ)
Name: Harry Campbell
195 North 1950 West
Salt Lake City, Utah 84114-4870
Telephone: (801) 536-4391
E-mail: hcampbell@utah.gov

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 61 00
COMMON PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 DEFINITIONS

A. Products:

1. New items for incorporation in the Work, whether purchased by Contractor or Owner for the Project, or taken from previously purchased stock, and may also include existing materials or components required for reuse.
2. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change meaning of such other terms used in Contract Documents, as those terms are self-explanatory and have well recognized meanings in construction industry.
3. Items identified by manufacturer's product name, including make or model designation, indicated in manufacturer's published product literature, that is current as of the date of the Contract Documents.

1.02 DESIGN REQUIREMENTS

A. Where Contractor design is specified, design of installation, systems, equipment, and components, including supports and anchorage, shall be in accordance with provisions of latest edition of International Building Code (IBC) by International Code Council and design parameters shown on the General Structural Notes on Drawings.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at 5,000 feet above sea level.

B. Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of minus 10 degrees F to 110 degrees F.

1.04 PREPARATION FOR SHIPMENT

A. When practical, factory assemble products. Mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable protective coating.

B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project and Contractor, equipment number, and approximate weight. Include complete packing list and bill of materials with each shipment.

C. Extra Materials, Special Tools, Test Equipment, and Expendables:

1. Furnish as required by individual Specifications.
2. Schedule:
    a. Ensure that shipment and delivery occurs concurrent with shipment of associated equipment.
    b. Transfer to Owner shall occur immediately subsequent to Contractor's acceptance of equipment from Supplier.
3. Packaging and Shipment:
    a. Package and ship extra materials and special tools to avoid damage during long term storage in original cartons insofar as possible, or in appropriately sized, hinged-cover, wood, plastic, or metal box.
    b. Prominently displayed on each package, the following:
        1) Manufacturer's part nomenclature and number, consistent with Operation and Maintenance Manual identification system.
        2) Applicable equipment description.
        3) Quantity of parts in package.
        4) Equipment manufacturer.
4. Replace extra materials and special tools found to be damaged or otherwise inoperable at time of transfer to Owner.

D. Request a minimum 7-day advance notice of shipment from manufacturer. Upon receipt of manufacturer's advance notice of shipment, promptly notify Engineer of anticipated date and place of equipment arrival.

E. Factory Test Results: Reviewed and accepted by Engineer before product shipment as required in individual Specification sections.

1.05 DELIVERY AND INSPECTION

A. Deliver products in accordance with accepted current Progress Schedule and coordinate to avoid conflict with the Work and conditions at Site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.

B. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable.

C. Unload products in accordance with manufacturer's instructions for unloading or as specified. Record receipt of products at Site. Promptly inspect for completeness and evidence of damage during shipment.

D. Remove damaged products from Site and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

1.06 HANDLING, STORAGE, AND PROTECTION

A. Handle and store products in accordance with manufacturer's written instructions and in a manner to prevent damage. Store in approved storage yards or sheds provided in accordance with Section 01 50 00, Temporary Facilities and Controls. Provide manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by Owner.

B. Manufacturer's instructions for material requiring special handling, storage, or protection shall be provided prior to delivery of material.

C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered, but not installed in the Work.

D. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60 degrees F. Protect electrical, instrumentation, and control products, and insulate against moisture, water, and dust damage. Connect and operate continuously space heaters furnished in electrical equipment.

E. Store fabricated products above ground on blocking or skids, and prevent soiling or staining. Store loose granular materials in well-drained area on solid surface to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.

F. Store finished products that are ready for installation in dry and well-ventilated areas. Do not subject to extreme changes in temperature or humidity.

G. After installation, provide coverings to protect products from damage due to traffic and construction operations. Remove coverings when no longer needed.

H. Hazardous Materials: Prevent contamination of personnel, storage area, and Site. Meet requirements of product specification, codes, and manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide manufacturer's standard materials suitable for service conditions, unless otherwise specified in the individual Specifications.

B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.

C. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.

D. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

E. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.

F. Equipment, Components, Systems, and Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.

G. Regulatory Requirement: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.

H. Safety Guards: Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal. Use 16-gauge or heavier; galvanized steel, aluminum coated steel, or galvanized or aluminum coated 1/2-inch mesh expanded steel. Provide galvanized steel accessories and supports, including bolts. For outdoors application, prevent entrance of rain and dripping water.

I. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

J. Equipment Finish:

1. Provide manufacturer’s standard finish and color, except where specific color is indicated.
2. If manufacturer has no standard color, provide equipment with gray finish as approved by Engineer.

K. Special Tools and Accessories: Furnish to Owner, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other spare parts as required for maintenance.

L. Lubricant: Provide initial lubricant recommended by equipment manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by Owner.

2.02 FABRICATION AND MANUFACTURE

A. General:

1. Manufacture parts to U.S.A. standard sizes and gauges.
2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
3. Design structural members for anticipated shock and vibratory loads.
4. Use 1/4-inch minimum thickness for steel that will be submerged, wholly or partially, during normal operation.

5. Modify standard products as necessary to meet performance Specifications.

B. Lubrication System:

1. Require no more than weekly attention during continuous operation.
2. Convenient and accessible; oil drains with bronze or stainless steel valves and fill-plugs easily accessible from the normal operating area or platform. Locate drains to allow convenient collection of oil during oil changes without removing equipment from its installed position.
3. Provide constant-level oilers or oil level indicators for oil lubrication systems.
4. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

2.03 SOURCE QUALITY CONTROL

A. Where Specifications call for factory testing to be witnessed by Engineer, notify Engineer not less than 14 days prior to scheduled test date, unless otherwise specified.

B. Calibration Instruments: Bear the seal of a reputable laboratory certifying instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).

C. Factory Tests: Perform in accordance with accepted test procedures and document successful completion.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing such effects. Remove damaged material or equipment from the Site and expedite delivery of identical new material or equipment. Delays to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays within Contractor’s control.

3.02 MANUFACTURER’S CERTIFICATE OF COMPLIANCE

A. When so specified, a Manufacturer’s Certificate of Compliance, a copy of which is attached to this section, shall be completed in full, signed by the entity supplying the product, material, or service, and submitted prior to shipment of product or material or the execution of the services.

B. Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.

C. Such form shall certify that the proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.

D. May reflect recent or previous test results on material or product, if acceptable to Engineer.

3.03 INSTALLATION

A. Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.

B. No shimming between machined surfaces is allowed.

C. Install the Work in accordance with NECA Standard of Installation, unless otherwise specified.

D. Repaint painted surfaces that are damaged prior to equipment acceptance.

E. Do not cut or notch any structural member or building surface without specific approval of Engineer.

F. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's instructions, and as may be specified. Retain a copy of manufacturers' instruction at Site, available for review at all times.

G. For material and equipment specifically indicated or specified to be reused in the Work:

1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
2. Arrange for transportation, storage, and handling of products that require offsite storage, restoration, or renovation. Include costs for such Work in the Contract Price.

3.04 FIELD FINISHING

A. In accordance with Section 09 90 00, Painting and Coating, and individual Specification sections.

3.05 ADJUSTMENT AND CLEANING

A. Perform required adjustments, tests, operation checks, and other startup activities.

3.06 LUBRICANTS

A. Fill lubricant reservoirs and replace consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

3.07 SUPPLEMENT

A. The supplement listed below, following “End of Section,” is part of this specification.

1. Manufacturer’s Certificate of Compliance.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER:

PRODUCT, MATERIAL, OR SERVICE SUBMITTED:

PROJECT NAME:

PROJECT NO:

Comments:_____

_____

_____

_____

_____

_____

I hereby certify that the above-referenced product, material, or service called for by the contract for the named project will be furnished in accordance with all applicable requirements. I further certify that the product, material, or service are of the quality specified and conform in all respects with the contract requirements, and are in the quantity shown.

Date of Execution: _____, 20___

Manufacturer:_____

Manufacturer's Authorized Representative *(print)*: _____

_____

(Authorized Signature)

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Submit prior to application for final payment.
   a. Record Documents: As required in General Conditions.
   b. Approved Shop Drawings and Samples: As required in the General Conditions.
   c. Special Bonds, Special Guarantees, and Service Agreements.
   d. Consent of Surety to Final Payment: As required in General Conditions.
   e. Releases or Waivers of Liens and Claims: As required in General Conditions.
   f. Releases from Agreements.
   g. Final Application for Payment: Submit in accordance with procedures and requirements stated in Section 01 29 00, Payment Procedures.
   h. Extra Materials: As required by individual Specification sections.

1.02 RECORD DOCUMENTS

A. Quality Assurance:

1. Furnish qualified and experienced person, whose duty and responsibility shall be to maintain record documents.
2. Accuracy of Records:
   a. Coordinate changes within record documents, making legible and accurate entries on each sheet of Drawings and other documents where such entry is required to show change.
   b. Purpose of Project record documents is to document factual information regarding aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive Site measurement, investigation, and examination.
3. Make entries within 24 hours after receipt of information that a change in the Work has occurred.

4. Prior to submitting each request for progress payment, request Engineer's review and approval of current status of record documents. Failure to properly maintain, update, and submit record documents may result in a deferral by Engineer to recommend whole or any part of Contractor's Application for Payment, either partial or final.

1.03 RELEASES FROM AGREEMENTS

A. Furnish Owner written releases from property owners or public agencies where side agreements or special easements have been made, or where Contractor's operations have not been kept within the Owner's construction right-of-way.

B. In the event Contractor is unable to secure written releases:

1. Inform Owner of the reasons.
2. Owner or its representatives will examine the Site, and Owner will direct Contractor to complete the Work that may be necessary to satisfy terms of the side agreement or special easement.
3. Should Contractor refuse to perform this Work, Owner reserves right to have it done by separate contract and deduct cost of same from Contract Price, or require Contractor to furnish a satisfactory bond in a sum to cover legal Claims for damages.
4. When Owner is satisfied that the Work has been completed in agreement with Contract Documents and terms of side agreement or special easement, right is reserved to waive requirement for written release if: (i) Contractor's failure to obtain such statement is due to grantor's refusal to sign, and this refusal is not based upon any legitimate Claims that Contractor has failed to fulfill terms of side agreement or special easement, or (ii) Contractor is unable to contact or has had undue hardship in contacting grantor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS

A. General:

1. Promptly following commencement of Contract Times, print from the provided PDF at Contractors expense, one complete set of Contract Documents. Drawings will be full size.
2. Label or stamp each record document with title, "RECORD DOCUMENTS," in neat large printed letters.

3. Record information concurrently with construction progress and within 24 hours after receipt of information that change has occurred. Do not cover or conceal Work until required information is recorded.

B. Preservation:

1. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
2. Make documents and Samples available at all times for observation by Engineer.

C. Making Entries on Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
   a. Color Coding:
      1) Green when showing information deleted from Drawings.
      2) Red when showing information added to Drawings.
      3) Blue and circled in blue to show notes.
2. Date entries.
3. Call attention to entry by "cloud" drawn around area or areas affected.
4. Legibly mark to record actual changes made during construction, including, but not limited to:
   a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
   b. Horizontal and vertical locations of existing and new Underground Facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements to permanent surface improvements.
   c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
   d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
   e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, and Engineer's written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.
5. Dimensions on Schematic Layouts: Show on record drawings, by dimension, the centerline of each run of items such as are described in previous subparagraph above.
   a. Clearly identify the item by accurate note such as "cast iron drain," "galv. water," and the like.

b. Show, by symbol or note, vertical location of item (“under slab,” “in ceiling plenum,” “exposed,” and the like).
c. Make identification so descriptive that it may be related reliably to Specifications.

3.02 FINAL CLEANING

A. At completion of the Work or of a part thereof and immediately prior to Contractor’s request for certificate of Substantial Completion; or if no certificate is issued, immediately prior to Contractor’s notice of completion, clean entire Site or parts thereof, as applicable.

1. Leave the Work and adjacent areas affected in a cleaned condition satisfactory to Owner and Resident Project Representative.
2. Remove grease, dirt, dust, paint or plaster splatter, stains, labels, fingerprints, and other foreign materials from exposed surfaces.
3. Repair, patch, and touch up marred surfaces to specified finish and match adjacent surfaces.
4. Clean all windows.
5. Clean and wax wood, vinyl, or painted floors.
6. Broom clean exterior paved driveways and parking areas.
7. Hose clean sidewalks, loading areas, and others contiguous with principal structures.
8. Rake clean all other surfaces.
9. Remove snow and ice from access to buildings.
10. Replace air-handling filters and clean ducts, blowers, and coils of ventilation units operated during construction.
11. Leave water courses, gutters, and ditches open and clean.

B. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Detailed information for the preparation, submission, and Engineer's review of Operations and Maintenance (O&M) Data, as required by individual Specification sections.

1.02 DEFINITIONS

A. Final Data: Engineer-accepted data, submitted as specified herein.

B. Maintenance Operation: As used on Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations are lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.

C. Preliminary Data: Initial and subsequent submissions for Engineer's review.

1.03 SEQUENCING AND SCHEDULING

A. Equipment and System Data:

1. Preliminary Data:
   a. Do not submit until Shop Drawing for equipment or system has been reviewed and approved by Engineer.
   b. Submit prior to shipment date.
2. Final Data: Submit Compilation Formatted and Electronic Media Formatted data prior to Substantial Completion of Project.

B. Materials and Finishes Data:

1. Preliminary Data: Submit at least 15 days prior to request for final inspection.
2. Final Data: Submit within 10 days after final inspection.

1.04 DATA FORMAT

A. Prepare preliminary and final data in the form of an instructional manual. Prepare preliminary and final data in electronic media format.

B. Electronic Media Format:

1. Portable Document Format (PDF):
   a. After all preliminary data has been found to be acceptable to Engineer, submit Operation and Maintenance data in PDF format on a portable USB drive.
   b. Files to be exact duplicates of Engineer-accepted preliminary data. Arrange by specification number and name.
   c. Files to be fully functional and viewable in most recent version of Adobe Acrobat.

1.05 SUBMITTALS

A. Informational:

1. Data Outline: Submit three copies of a detailed outline of proposed organization and contents of Final Data prior to preparation of Preliminary Data.
2. Preliminary Data:
   a. Submit two copies for Engineer's review.
   b. If data meets conditions of the Contract:
      1) One copy will be returned to Contractor.
      2) One copy will be retained in Engineer's file.
   c. If data does not meet conditions of the Contract:
      1) All copies will be returned to Contractor with Engineer's comments (on separate document) for revision.
      2) Engineer's comments will be retained in Engineer's file.
      3) Resubmit two copies revised in accordance with Engineer's comments.
3. Final Data: Submit two copies in formats specified herein.

1.06 DATA FOR EQUIPMENT AND SYSTEMS

A. Content For Each Unit (or Common Units) and System:

1. Product Data:
   a. Include only those sheets that are pertinent to specific product.
   b. Clearly annotate each sheet to:
      1) Identify specific product or part installed.
      2) Identify data applicable to installation.
      3) Delete references to inapplicable information.
   c. Function, normal operating characteristics, and limiting conditions.
   d. Performance curves, engineering data, nameplate data, and tests.
   e. Complete nomenclature and commercial number of replaceable parts.

f. Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
g. Spare parts ordering instructions.
h. Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).

2. As-installed, color-coded piping diagrams.
3. Charts of valve tag numbers, with the location and function of each valve.
4. Drawings: Supplement product data with Drawings as necessary to clearly illustrate:
   a. Format:
      1) Provide reinforced, punched, binder tab; bind in with text.
      2) Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.
      3) Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.
      4) Identify Specification section and product on Drawings and envelopes.
   b. Relations of component parts of equipment and systems.
   c. Control and flow diagrams.
   d. Coordinate Drawings with Project record documents to assure correct illustration of completed installation.
5. Instructions and Procedures: Within text, as required to supplement product data.
   a. Format:
      1) Organize in consistent format under separate heading for each different procedure.
      2) Provide logical sequence of instructions for each procedure.
      3) Provide information sheet for Owner's personnel, including:
         a) Proper procedures in event of failure.
         b) Instances that might affect validity of guarantee or Bond.
   b. Installation Instructions: Including alignment, adjusting, calibrating, and checking.
   c. Operating Procedures:
      1) Startup, break-in, routine, and normal operating instructions.
      2) Test procedures and results of factory tests where required.
      3) Regulation, control, stopping, and emergency instructions.
      4) Description of operation sequence by control manufacturer.
      5) Shutdown instructions for both short and extended duration.
      6) Summer and winter operating instructions, as applicable.
      7) Safety precautions.
      8) Special operating instructions.

d. Maintenance and Overhaul Procedures:
   1) Routine maintenance.
   2) Guide to troubleshooting.
   3) Disassembly, removal, repair, reinstallation, and re-assembly.

6. Guarantee, Bond, and Service Agreement: In accordance with Section 01 77 00, Closeout Procedures.

B. Content for Each Electric or Electronic Item or System:

1. Description of Unit and Component Parts:
   a. Function, normal operating characteristics, and limiting conditions.
   b. Performance curves, engineering data, nameplate data, and tests.
   c. Complete nomenclature and commercial number of replaceable parts.
   d. Interconnection wiring diagrams, including control and lighting systems.
2. Circuit Directories of Panelboards:
   a. Electrical service.
   b. Control requirements and interfaces.
   c. Communication requirements and interfaces.
   d. List of electrical relay settings, and control and alarm contact settings.
3. Electrical interconnection wiring diagram, including as applicable, single-line, three-line, schematic and internal wiring, and external interconnection wiring.
4. As-installed control diagrams by control manufacturer.
5. Operating Procedures:
   a. Routine and normal operating instructions.
   b. Startup and shutdown sequences, normal and emergency.
   c. Safety precautions.
   d. Special operating instructions.
6. Maintenance Procedures:
   a. Routine maintenance.
   b. Guide to troubleshooting.
   c. Adjustment and checking.
   d. List of relay settings, control and alarm contact settings.
7. Manufacturer’s printed operating and maintenance instructions.
8. List of original manufacturer’s spare parts, manufacturer’s current prices, and recommended quantities to be maintained in storage.

C. Maintenance Summary:

1. Compile individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or sub-units.
2. Format:
   a. Use Maintenance Summary Form bound with this section or electronic facsimile of such.
   b. Each Maintenance Summary may take as many pages as required.
   c. Use only 8-1/2-inch by 11-inch size paper.
   d. Complete using typewriter or electronic printing.
3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
4. Recommended Spare Parts:
   a. Data to be consistent with manufacturer's Bill of Materials/Parts List furnished in O&M manuals.
   b. "Unit" is the unit of measure for ordering the part.
   c. "Quantity" is the number of units recommended.
   d. "Unit Cost" is the current purchase price.

1.07 DATA FOR MATERIALS AND FINISHES

A. Content for Architectural Products, Applied Materials, and Finishes:

1. Manufacturer's data, giving full information on products:
   a. Catalog number, size, and composition.
   b. Color and texture designations.
   c. Information required for reordering special-manufactured products.
2. Instructions for Care and Maintenance:
   a. Manufacturer's recommendation for types of cleaning agents and methods.
   b. Cautions against cleaning agents and methods that are detrimental to product.
   c. Recommended schedule for cleaning and maintenance.

B. Content for Moisture Protection and Weather Exposed Products:

1. Manufacturer's data, giving full information on products:
   a. Applicable standards.
   b. Chemical composition.
   c. Details of installation.
2. Instructions for inspection, maintenance, and repair.

1.08 SUPPLEMENT

A. The supplement listed below, following “End of Section,” is a part of this Specification.

1. Maintenance Summary Form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

MAINTENANCE SUMMARY FORM

PROJECT:_____ CONTRACT NO.:_____

1. EQUIPMENT ITEM_____

2. MANUFACTURER _____

3. EQUIPMENT/TAG NUMBER(S) _____

4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS)_____

5. NAMEPLATE DATA (hp, voltage, speed, etc.) _____

6. MANUFACTURER'S LOCAL REPRESENTATIVE _____

   a. Name_____ Telephone No. _____

   b. Address _____

7. MAINTENANCE REQUIREMENTS

Maintenance Operation Comments	**Frequency**	**Lubricant (If Applicable)**
List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable. (Reference to manufacturer's catalog or sales literature is not acceptable.)	List required frequency of each maintenance operation.	Refer by symbol to lubricant required.

8. LUBRICANT LIST

Reference Symbol	Shell	Exxon Mobile	Chevron Texaco	BP Amoco	"Or-Equal"
List symbols used in No. 7 above.	List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.				

9. RECOMMENDED SPARE PARTS FOR OWNER'S INVENTORY.

Part No.	Description	Unit	Quantity	Unit Cost
Note: Identify parts provided by this Contract with two asterisks.				

SECTION 01 88 15
ANCHORAGE AND BRACING

PART 1 GENERAL

1.01 SUMMARY

A. This section covers requirements for anchorage and bracing of equipment, distribution systems, and other nonstructural components required in accordance with the ICC 2021 International Building Code (IBC), for seismic, wind, gravity, soil, and operational loads.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Institute of Steel Construction (AISC) 360, Specification for Structural Steel Buildings.
2. American Society of Civil Engineers (ASCE): ASCE 7, Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
3. International Code Council (ICC): International Building Code (IBC).
4. State of Utah.

1.03 DEFINITIONS

A. Authority Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.

B. Designated Seismic System: Architectural, electrical, and mechanical system or their components for which component importance factor is greater than 1.0.

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. General:

1. Anchorage and bracing systems shall be designed by a qualified professional engineer registered in the State of Utah.
2. Design anchorage into concrete including embedment in accordance with ACI 318; Chapter 17 (or other industry standard approved by Engineer), and Project Specifications. Unless otherwise noted, design for cracked concrete condition.
3. Design anchorage and bracing of architectural, mechanical, and electrical components and systems in accordance with this section, unless a design is specifically provided within Contract Documents or where exempted hereinafter.
4. Design attachments, braces, and anchors for equipment, components, and distribution systems to structure for gravity, seismic, wind, and operational loading.
5. Anchor and brace piping and ductwork, whether exempt or not exempt for this section, so that lateral or vertical displacement does not result in damage or failure to essential architectural, mechanical, or electrical equipment.
6. Architectural Components: Includes, but are not limited to, nonstructural walls and elements, partitions, cladding and veneer, access flooring, signs, cabinets, suspended ceilings, and glass in glazed curtain walls and partitions.
7. Provide supplementary framing where required to transfer anchorage and bracing loads to structure.
8. Adjust equipment pad sizes or provide additional anchorage confinement reinforcing to provide required anchorage capacities.
9. Design anchorage and bracing for:
    a. Equipment and components that weigh more than 400 pounds and have center of mass located 4 feet or less above adjacent finished floor.
    b. Equipment weighing more than 20 pounds that has center of mass located more than 4 feet above adjacent finished floor.
    c. Distribution systems that weigh more than 5 pounds per foot that have center of mass located more than 4 feet above adjacent finished floor.
10. For components exempted from design requirements of this section, provide bolted, welded, or otherwise positively fastened attachments to supporting structure.

B. Design Loads:

1. Gravity: Design anchorage and bracing for self-weight and superimposed loads on components and equipment.
2. Wind: Design anchorage and bracing for wind criteria provided on General Structural Notes on Drawings for exposed architectural components and exterior and wind-exposed mechanical and electrical equipment. Alternately, manufacturer certification may be provided for components such as roofing and flashing to verify attachments meet Project-specific design criteria.
3. Operational:
    a. For loading supplied by equipment manufacturer for IBC required load cases.
    b. Loads may include equipment vibration, torque, thermal effects, effects of internal contents (weight and sloshing), water hammer, and other load-inducing conditions.
    c. Locate braces to minimize vibration to or movement of structure.
    d. For vibrating loads, use anchors meeting requirements of Section 05 50 00, Metal Fabrications, or Section 05 05 19, Post-Installed Anchors, for anchors with designated capacities for vibratory loading per manufacturer's ICC-ES report.
4. Hydraulic: Design of anchorage for submerged mechanical equipment shall include hydrostatic and hydrodynamic loads determined in accordance with Section 15.7 of ASCE 7.
5. Seismic:
    a. In accordance with 2021 IBC, Section 1613, and Chapter 13 of ASCE 7.
    b. Design anchorage and bracing for design criteria listed on General Structural Notes on Drawings.
    c. Design forces for anchors in concrete or masonry shall be in accordance with ASCE 7, Section 13.4.2 as applicable for Project Seismic Design Category.

C. Seismic Design Requirements:

1. Analyze local region of body of nonstructural component for load transfer of anchorage attachment if component Ip equals 1.5.
2. Provide support drawings and calculations for electrical distribution components if any of the following conditions apply:
    a. Conduit diameter is greater than 2.5-inch trade size.
    b. Total weight of bus duct, cable tray, or conduit supported by trapeze assemblies exceeds 10 pounds per foot.
3. Other seismic design and detailing information identified in ASCE 7, Chapter 13, is required to be provided for new architectural, mechanical and electrical components, systems, or equipment.

1.05 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. List of architectural, mechanical, and electrical equipment requiring Contractor-designed anchorage and bracing, unless specifically exempted.
   b. Manufacturers' engineered seismic and non-seismic hardware product data.
   c. Attachment assemblies' drawings including seismic attachments; include connection hardware, braces, and anchors or anchor bolts for nonexempt components, equipment, and systems.
   d. Submittal will be rejected if proposed anchorage method would create excessive stress to supporting member. Revise anchorages and strengthen structural support to eliminate overstressed condition.

B. Informational Submittals:

1. Anchorage and Bracing Calculations: For attachments, braces, and anchorages, include IBC and Project-specific criteria as noted on General Structural Notes on Drawings, in addition to manufacturer's specific criteria used for design; sealed by a civil or structural engineer registered in the State of Utah.
2. Manufacturer's hardware installation requirements.

C. Deferred Submittals:

1. Submitted seismic anchorage drawings and calculations are identified as IBC deferred submittals and will be submitted to and must be accepted by AHJ prior to installation of component, equipment, or distribution system.
2. Submit deferred Action Submittals such as Shop Drawings with supporting deferred informational submittals such as calculations no less than 4 weeks in advance of installation of component, equipment or distribution system to be anchored to structure.

1.06 SOURCE QUALITY CONTROL

A. Contractor and supplier responsibilities to accommodate Owner-furnished shop fabrication related special inspections and testing are provided in Project's Statement of Special Inspections in Supplement located at the end of Section 01 45 33, Special Inspection, Observation, and Testing.

B. Provide all other specified, regulatory required, or required repair verification inspection and testing that is not listed in Statement of Special Inspections in accordance with Section 01 45 16.13, Contractor Quality Control.

C. Provide Source Quality Control for welding and hot-dip galvanizing of anchors in accordance with Section 05 50 00, Metal Fabrications.

PART 2 PRODUCTS

2.01 GENERAL

A. Design and construct attachments and supports transferring seismic and non-seismic loads to structure of materials and products suitable for application and in accordance with design criteria shown on Drawings and nationally recognized standards.

B. Provide anchor bolts for anchorage of equipment to concrete or masonry in accordance with Section 05 50 00, Metal Fabrications. Provide anchor bolts of the size, minimum embedment, and spacing designated in calculations submitted by Contractor and accepted by Engineer.

C. Provide post-installed concrete and masonry anchors for anchorage of equipment to concrete or masonry in accordance with Section 05 05 19, Post-Installed Anchors. Provide post-installed anchors of the size, minimum embedment, and spacing designated in calculations submitted by Contractor and accepted by Engineer.

D. Do not use powder-actuated fasteners or sleeve anchors for seismic attachments and anchorage where resistance to tension loads is required. Do not use expansion anchors, other than undercut anchors, for nonvibration isolated mechanical equipment rated over 10 hp.

PART 3 EXECUTION

3.01 GENERAL

A. Make attachments, bracing, and anchorage in such a manner that component lateral force is transferred to lateral force resisting system of structure through a complete load path.

B. Design, provide, and install overall seismic anchorage system to provide restraint in all directions, including vertical, for each component or system so anchored.

C. Provide snubbers in each horizontal direction and vertical restraints for components mounted on vibration isolation systems where required to resist overturning.

D. Provide piping anchorage that maintains design flexibility and expansion capabilities at flexible connections and expansion joints. Piping and ductwork suspended more than 12 inches below supporting structure shall be braced for seismic effects to avoid significant bending of hangers and their attachments, unless high- or limited- deformability piping is used per ASCE 7, Section 13.6.8 or HVAC ducts have a cross-sectional area of less than 6 square feet or weigh 17 pounds per foot or less.

E. Anchor tall and narrow equipment such as motor control centers and telemetry equipment at base and within 12 inches from top of equipment, unless approved otherwise by Engineer.

F. Do not attach architectural, mechanical, or electrical components to more than one element of a building structure at a single restraint location where such elements may respond differently during a seismic event. Do not make such attachments across building expansion and contraction joints.

3.02 INSTALLATION

A. Do not install components or their anchorages or restraints prior to review and acceptance by Engineer and AHJ.

B. Notify Engineer upon completion of installation of seismic restraints in accordance with Section 01 45 33, Special Inspection, Observation, and Testing.

3.03 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. In accordance with Section 05 50 00, Metal Fabrications, and Section 05 05 19, Post-Installed Anchors.

B. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

C. Provide any other specified, regulatory required, or required repair verification inspection and testing that is not listed in Statement of Special Inspections in accordance with Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 01 91 14
EQUIPMENT TESTING AND FACILITY STARTUP

PART 1 GENERAL

1.01 DEFINITIONS

A. Facility: Entire Project, or an agreed-upon portion.

B. Functional Test: Test or tests in presence of Engineer and Owner to demonstrate that installed equipment meets manufacturer's installation, calibration, and adjustment requirements and other requirements as specified.

C. Performance Test: Test or tests performed after any required functional test in presence of Engineer and Owner to demonstrate and confirm individual equipment meets performance requirements specified in individual sections.

D. Unit Process: As used in this section, a unit process is a portion of the facility that performs a specific process function, such as metering flows, isolation valves, air valves, and other system components critical to the operation of the system.

E. Facility Performance Demonstration:

1. A demonstration, conducted by Contractor, with assistance of Owner, to demonstrate and document the performance of the entire operating facility, both manually and automatically (if required), based on criteria developed in conjunction with Owner and as accepted by Engineer.
2. Such demonstration is for the purposes of (i) verifying to Owner entire facility performs as a whole, and (ii) documenting performance characteristics of completed facility for Owner's records. Neither the demonstration nor the evaluation is intended in any way to make performance of a unit process or entire facility the responsibility of Contractor, unless such performance is otherwise specified.

1.02 SUBMITTALS

A. Informational Submittals:

1. Facility Startup and Performance Demonstration Plan.
2. Functional and performance test results.
3. Completed Unit Process Startup Form for each unit process.
4. Completed Facility Performance Demonstration/Certification Form.

1.03 FACILITY STARTUP AND PERFORMANCE DEMONSTRATION PLAN

A. Develop a written plan, in conjunction with Owner's operations personnel; to include the following:

1. Step-by-step instructions for startup of each unit process and the complete facility.
2. Unit Process Startup Form (sample attached), to minimally include the following:
    a. Description of the unit process, including equipment numbers/nomenclature of each item of equipment and all included devices.
    b. Detailed procedure for startup of the unit process, including valves to be opened/closed, order of equipment startup, etc.
    c. Startup requirements for each unit process, including water, power, chemicals, etc.
    d. Space for evaluation comments.
3. Facility Performance Demonstration/Certification Form (sample attached), to minimally include the following:
    a. Description of unit processes included in the facility startup.
    b. Sequence of unit process startup to achieve facility startup.
    c. Description of computerized operations, if any, included in the facility.
    d. Contractor certification facility is capable of performing its intended function(s), including fully automatic operation.
    e. Signature spaces for Contractor and Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Facility Startup Meetings: Schedule, in accordance with requirements of Section 01 31 19, Project Meetings, to discuss test schedule, test methods, materials, chemicals and liquids required, facilities operations interface, and Owner involvement.

B. Contractor's Testing and Startup Representative:

1. Designate and furnish one or more personnel to coordinate and expedite testing and facility startup.
2. Representative(s) shall be present during startup meetings and shall be available at all times during testing and startup.

C. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required for testing and startup.

D. Provide Subcontractor and equipment manufacturers' staff adequate to prevent delays. Schedule ongoing work so as not to interfere with or delay testing and startup.

3.02 EQUIPMENT TESTING

A. Preparation:

1. Complete installation before testing.
2. Furnish qualified manufacturers' representatives, when required by individual Specification sections.
3. Obtain and submit from equipment manufacturer's representative Manufacturer's Certificate of Proper Installation Form, in accordance with Section 01 43 33, Manufacturers' Field Services, when required by individual Specification sections.
4. Equipment Test Report Form: Provide written test report for each item of equipment to be tested, to include the minimum information:
    a. Owner/Project Name.
    b. Equipment or item tested.
    c. Date and time of test.
    d. Type of test performed (Functional or Performance).
    e. Test method.
    f. Test conditions.
    g. Test results.
    h. Signature spaces for Contractor and Engineer as witness.
5. Cleaning and Checking:
    a. Prior to beginning functional testing:
        1) Calibrate testing equipment in accordance with manufacturer's instructions.
        2) Inspect and clean equipment, devices, connected piping, and structures to ensure they are free of foreign material.
        3) Lubricate equipment in accordance with manufacturer's instructions.
        4) Turn rotating equipment by hand when possible to confirm that equipment is not bound.
        5) Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
        6) Check power supply to electric-powered equipment for correct voltage.
        7) Adjust clearances and torque.
        8) Test piping for leaks.

6. Ready-to-test determination will be by Resident Project Representative based at least on the following:
    a. Acceptable Operation and Maintenance Data.
    b. Notification by Contractor of equipment readiness for testing.
    c. Receipt of Manufacturer's Certificate of Proper Installation, if so specified.
    d. Adequate completion of work adjacent to, or interfacing with, equipment to be tested.
    e. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment.
    f. Satisfactory fulfillment of other specified manufacturer's responsibilities.
    g. Equipment and electrical tagging complete.
    h. Delivery of all spare parts and special tools.

B. Functional Testing:

1. Conduct as specified in individual Specification sections.
2. Notify Owner and Engineer in writing at least 10 days prior to scheduled date of testing.
3. Prepare Equipment Test Report summarizing test method and results.
4. When, in Engineer's opinion, equipment meets functional requirements specified, such equipment will be accepted for purposes of advancing to performance testing phase, if so, required by individual Specification sections. Such acceptance will be evidenced by Engineer/Owner's signature as witness on Equipment Test Report.

C. Performance Testing:

1. Conduct as specified in individual Specification sections.
2. Notify Engineer and Owner in writing at least 10 days prior to scheduled date of test.
3. Performance testing shall not commence until equipment has been accepted by Engineer as having satisfied functional test requirements specified.
4. Type of fluid, gas, or solid for testing shall be as specified.
5. Unless otherwise indicated, furnish labor, materials, and supplies for conducting the test and taking samples and performance measurements.
6. Prepare Equipment Test Report summarizing test method and results.
7. When, in Engineer's opinion, equipment meets performance requirements specified, such equipment will be accepted as to conforming to Contract requirements. Such acceptance will be evidenced by Engineer's signature on Equipment Test Report.

3.03 FACILITY PERFORMANCE DEMONSTRATION

A. When, in the opinion of Engineer, startup of all unit processes has been achieved, sequence each unit process to the point that facility is operational.

B. Demonstrate proper operation of required interfaces within and between individual unit processes and equipment.

3.04 SUPPLEMENTS

A. Supplements listed below, following "End of Section," are a part of this Specification:

1. Unit Process Startup Form.
2. Facility Performance Demonstration/Certification Form.

END OF SECTION

UNIT PROCESS STARTUP FORM

OWNER:_____ **PROJECT:**_____

Unit Process Description: (Include description and equipment number of all equipment and devices):

Startup Procedure (Describe procedure for sequential startup and evaluation, including valves to be opened/closed, order of equipment startup, etc.):

Startup Requirements (Water, power, chemicals, etc.):_____

Evaluation Comments:_____

FACILITY PERFORMANCE DEMONSTRATION/CERTIFICATION FORM

OWNER:_____ **PROJECT:**_____

Unit Processes Description (List unit processes involved in facility startup):

_____

_____

_____

_____

Unit Processes Startup Sequence (Describe sequence for startup, including computerized operations, if any):

_____

_____

_____

_____

_____

Contractor Certification that Facility is capable of performing its intended function(s), including fully automatic operation:

Contractor: _____ **Date:** _____**, 20**____

Engineer: _____ **Date:** _____**, 20**____
(Authorized Signature)

SECTION 02 11 00
EXISTING UTILITIES: COORDINATION AND RELOCATION

PART 1 GENERAL

1.01 GENERAL UTILITY IDENTIFICATION, COORDINATION, AND RELOCATION REQUIREMENTS

A. This section addresses work to locate, support, coordinate, and relocate existing utilities, both those shown on Drawings and those not shown. Existing utilities include water, sewer, irrigation, storm drain, gas, electric, telephone, TV, communication, traffic control, and other utility lines, both underground and overhead, and both mains and service lines.

B. The Contractor must perform work to expose and survey location of existing utilities sufficiently in advance of construction to locate conflicts and allow for their timely resolution to prevent construction work delays.

1.02 SUBMITTALS

A. Utility Record Drawings: For all utility relocation work constructed by the Contractor, provide As-Built or Record Utility Drawings to the Engineer and to each Utility Company in the electronic file format specified by the Engineer and also as a hard copy. Drawings shall show the locations of existing utilities, structures, trees, streets, and ROW limits.

1.03 IDENTIFICATION OF UTILITIES AND INVESTIGATIONS BY THE CONTRACTOR

A. The Contractor shall perform the following investigations prior to commencement of construction in a particular area:

1. A minimum of 14 days prior to crossing of any existing utilities the Contractor shall uncover and survey the location of each utility.
2. This Work Includes for each Existing Utility: Blue staking, traffic control, exposing with a backhoe or vacuum excavating each utility; surveying, backfilling, and surface repair.
3. Contractor shall obtain required City permits prior to potholing utilities.

B. The Contractor shall take all actions that the Contractor deems necessary to verify the existence, exact location, and size of all utilities in such areas that are shown in the Contract as requiring relocation, such as, conducting field studies.

C. If the Contractor's investigations identify utilities not described in the Contract Documents or if they result in a determination that any utility was not accurately indicated therein, then the Contractor shall notify the Engineer immediately.

1.04 UTILITY NOTIFICATION AND COORDINATION

A. Contractor shall take the coordination lead role and be proactive in coordinating with other contractors, utility owners, and land owners for the construction of the work. The Contractor shall contact, schedule and establish utility shut down times and determine the relocation and/or replacement requirements of existing utilities prior to the start of any work. For Utility Companies performing their own work, schedule adequate time, for utility work, for which the Contractor is responsible, perform the work.

B. Contractor shall be sure that operation of existing sewer, drainage, domestic water, and other utility systems (i.e., irrigation during irrigation season) are continuous during construction. Existing service laterals are not shown on Drawings. The Contractor shall not assume there are any fewer service laterals (for water sewer, gas, and other utilities, whether shown on Drawings or not) than there are homes or potentially occupied structures, where project trenches are located in or within 100 feet of a street between a home or structure and the utility main.

C. Coordinate utility shut downs and relocations with utility owners, residence and businesses along the alignment, and the Contractor's Public Information Manager.

D. Where necessary, the Contractor shall install and maintain bypass facilities required to keep necessary existing utilities in service for the Work to be performed on schedule. If existing water pipes must be taken out of service during construction for safety reasons, provide above ground pipes (high lining) to maintain continuous water services to homes and any fire hydrants, equivalent to existing system service. Submit to Utility Owner planned means and methods (and obtain utility owner approval for such) to protect all water mains during construction.

E. Pipe construction in several project areas is near existing water mains which without appropriate Contractor provided sheeting, shoring, and protection, could collapse into the excavations required for the project work. The Contractor is required to provide all necessary OSHA compliant designs for sheeting, shoring, and other protection to prevent existing water systems from shifting, leaking, collapsing, or otherwise failing as a result of this work, into the project excavation before or after backfilling of project work.

F. Notify applicable Utility Owner a minimum of 14 days prior to commencing work of any conflicting utilities. Coordinate with each Utility Owner so that relocations do not delay contract Work.

1.05 UTILITY RELOCATION AND REPAIR

A. Relocating Utilities: Perform all work to move the existing utility, at Contractor's sole expense (unless noted otherwise), so that moved utility is not in conflict with facilities built under this project, and in such a way that the utility owners requirements are met and the construction schedule is not delayed or adversely impaired. This requires Contractor to initiate and maintain early and proactive coordination with the utility owner, obtaining cost of relocation estimates from the utility company, scheduling, providing for design and performing the relocation, and where utility owner requires doing the work themselves, paying Utility Owner to perform the work. The utility shall be relocated or replaced to the satisfaction of the Utility Owner and at no additional cost to the Utility Owner.

B. Service Laterals: Service laterals for any utility are not shown on Drawings. Remove, relocate or replace service laterals which conflict with the work at the cost of the Contractor. Do not assume there are any fewer service laterals (water, sewer, gas, phone, TV, electric, and other services, whether shown on Drawings or not) than there are homes (or other occupied structures) fronting on street in which the work is located. Remove, maintain, and relocate utility service lines to the satisfaction and standards of Utility Owner. Water service lines damaged or destroyed during project Work shall be entirely replaced with new materials from water main to water meter.

C. Support: The Contractor shall support existing utilities during construction. Contractor shall be responsible for the cost of replacing any utilities that are damaged as a result of construction. This includes damage to curb, gutter, and sidewalk. Protect from damage and by providing Contractor design support system to support facility in its existing position. Provide backfilling support for facility in its existing position per Drawings and specifications.

D. In landscaped areas within the project work limits the Contractor shall remove, replace, and repair any irrigation and sprinkler systems, including electrical controls, that interfere with the work. Existing irrigation and sprinkler systems are not shown on Drawings. Contractor shall assume any landscaped or improved area includes irrigation and sprinkler systems for maintaining existing landscape.

1.06 PROTECT STORM DRAIN SYSTEMS

A. Protect storm drain systems from construction sediments and debris and comply with all permit requirements.

B. Obtain Utility Owner approval prior to discharging water or other materials (except storm water not laden with construction sediments/materials) into their system.

1.07 WORK EXCLUDED FROM SCOPE

A. The Utility Relocation Work excludes the following:

1. Utility Main Relocations Not Shown or Identified on Drawings: If Contractor's utility relocation work (as described below) finds that a utility main is in conflict with the pipeline trench, appurtenance, BO pipes, and gravity utilities (sewers, storm drains and gravity irrigation pipelines), which cannot be resolved by supporting the utility in place, deflecting the new pipe, or providing another simple resolution, the Contractor shall prepare with utility owner and Engineer a utility relocation plan. The cost of the plan and the utility relocation work incurred by the Contractor shall be paid for by the Owner as provided in these Contract Documents.
2. Utility Mains Shown on Drawings Requiring Relocation: If Contractor's work finds that a parallel utility main shown on Drawings is located less than 7 feet horizontal from the centerline of the pipeline, the Contractor shall notify the Engineer immediately to determine if the alignment of the pipeline can be adjusted to avoid conflict or if a utility relocation is required.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 117, Specification for Tolerances for Concrete Construction and Materials.
   a. 350.5, Specifications for Environmental Concrete Structures.
   b. 350, Code Requirements for Environmental Engineering Concrete Structures.
2. NSF International (NSF): 61, Drinking Water System Components-Health Effects.

1.02 DEFINITIONS

A. Architectural Concrete: See definition in Section 03 30 00, Cast-in-Place Concrete.

B. Defective Areas: See definition in Section 03 30 00, Cast-in-Place Concrete.

C. Exposed Concrete: See definition in Section 03 30 00, Cast-in-Place Concrete.

1.03 DESIGN REQUIREMENTS

A. Design formwork in accordance with ACI 350.5 and ACI 350 to provide concrete finishes specified in Section 03 30 00, Cast-in-Place Concrete.

B. Unless otherwise specified, limit deflection of facing materials for concrete surfaces to comply with ACI 350.5. Limit deflection of facing materials to comply with tolerance limits established by Contract Documents and with tolerances required by equipment manufacturers. Coordinate tolerance requirements with equipment manufacturers.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings.

2. Product Data:
    a. Form release agent.
    b. Form ties.
    c. Products to be used for sealing tie holes.

B. Informational Submittals: Statement of qualifications for formwork designer.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Formwork Designer: Formwork, falsework, and shoring design shall be designed by an engineer licensed in the state of Project.

PART 2 PRODUCTS

2.01 FORM MATERIALS

A. Wall Forms and Underside of Slabs and Beams:

1. Materials: Plywood, hard plastic finished plywood, overlaid waterproof particle board, or steel in "new and undamaged" condition, of sufficient strength and surface smoothness to produce specified finish.
2. Where steel forms are used, treat steel surfaces to prevent rusting using products approved for use on steel forms.
3. Circular Structure:
    a. Wall forms shall conform to circular shape of structure.
    b. Straight panels may be substituted for circular forms provided panels do not exceed 2 feet in horizontal width and angular deflection is no greater than 3-1/2 degrees per joint.

B. Column Forms:

1. Circular Columns: Fabricated steel or fiber-reinforced plastic with bolted sections or spirally wound laminated fiber form. Internally treat with release agent for full height of column.

C. All Other Forms: Materials as specified for wall forms.

2.02 ACCESSORIES

A. Form Release Agent:

1. Material:
    a. Shall not bond with, stain, or adversely affect concrete surfaces.
    b. Shall not impair subsequent treatments of concrete surfaces when applied to forms.

c. Ready-to-use water-based material formulated to reduce or eliminate surface imperfections.
d. Contain no mineral oil or organic solvents.

2. Manufacturers and Products: Not for surfaces exposed to potable water.
   a. BASF, Shakopee, MN; MBT MasterFinish RL 211.
   b. Cresset Chemical Company; Crete-Lease 20-VOC-Xtra.
3. Manufacturers and Products: For use with potable water structures. Environmentally safe, meeting local, state, and federal regulations and usable in potable water facilities. Certified as meeting NSF 61.
   a. Atlas Tech Products; Atlas Bio-Guard.
   b. Dayton Superior; Clean Strip J1EF.
   c. Hill and Griffith Company; Grifcote LV-50-Plus.

B. Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

C. Form Snap-Ties:

1. Material: Stainless steel.
2. Spreader Inserts:
   a. Conical or spherical type.
   b. Design to maintain positive contact with forming material.
   c. Furnish units that will leave no metal closer than 1.5 inches to concrete surface when forms, inserts, and tie ends are removed.
3. Wire ties not permitted.
4. Flat bar ties for panel forms; furnish plastic or rubber inserts with minimum 1.5-inch depth and sufficient dimensions to permit patching of tie hole.

D. Form Snap-Ties with Water Stop:

1. For water-holding structures, basements, pipe galleries, and accessible spaces below finish grade, furnish one of the following:
   a. Integral stainless steel water stop 0.103-inch thick and 0.625-inch diameter tightly and continuously welded to tie.
   b. Neoprene water stop 3/16-inch thick and 15/16-inch diameter whose center hole is one-half diameter of tie, or molded plastic water stop of comparable size.
   c. Orient water stop perpendicular to tie and symmetrical about center of tie.
   d. Design ties to prevent rotation or disturbance of center portion of tie during removal of ends and to prevent water leaking along tie.

E. Through-Bolts:

1. At Contractor's option, may be used as alternate to form snap-tie or form snap-tie with water stop.
2. Tapered minimum 1-inch diameter at smallest end.
3. Elastic Vinyl Plug for Through-Bolt Tie Holes:
   a. Design and size of plug to allow insertion with tool to enable plug to elongate and return to original length and diameter upon removal; forms watertight seal.
   b. Manufacturers and Products:
      1) Dayton Superior, Miamisburg, OH; A58 Sure Plug.
      2) Greenstreak Group, Inc., St Louis, MO; X-Plug.

PART 3 EXECUTION

3.01 FORM SURFACE PREPARATION

A. Prior to coating surface, thoroughly clean form surfaces that will be in contact with concrete or that have been in contact with previously cast concrete, dirt, and other surface contaminants.

B. Exposed Wood Forms in Contact with Concrete: Apply form release agent as recommended by manufacturer.

C. Steel Forms: Apply form release agent as soon as they are cleaned to prevent discoloration of concrete from rust.

3.02 ERECTION

A. General: In accordance with ACI 301, unless otherwise specified.

B. Beveled Edges (Chamfer):

1. Form 3/4-inch bevels at concrete edges, unless otherwise shown.
2. Where beveled edges on existing adjacent structures are other than 3/4 inch, obtain Engineer's approval of size prior to placement of beveled edge.

C. Wall Forms:

1. Do not reuse forms with damaged surfaces.
2. Locate form ties and joints in uninterrupted uniform pattern.
3. Inspect form surfaces prior to installation to ensure conformance with specified tolerances.

D. Curb, Sidewalk, and Driveway Forms:

1. Provide standard steel or wood forms.
2. Set forms to true lines and grades, and securely stake in position.

E. Form Tolerances:

1. Provide forms in accordance with ACI 117 and ACI 318, and the following tolerances for finishes specified:
    a. See the Schedule of Concrete Finishes in Section 03 30 00, Cast-in-Place Concrete, for beam, column, and wall types related to required form tolerances.
    b. Wall Tolerances:
        1) Straight Vertical or Horizontal Wall Surface: Flat planes within tolerance specified.
        2) Wall Type W-A:
            a) Plumb within 1/4 inch in 10 feet or within 1 inch from top to bottom for walls over 40 feet high.
            b) Depressions in Wall Surface: Maximum 5/16 inch when 10-foot straightedge is placed on high points in all directions.
        3) Wall Type W-B:
            a) Plumb within 1/8 inch in 10 feet or within 1/2 inch from top to bottom for walls over 40 feet high.
            b) Depressions in Wall Surface: Maximum 1/8 inch when 10-foot straightedge is placed on high points in all directions.
        4) Thickness: Maximum 1/4 inch minus or 1/2 inch plus from dimension shown.
        5) Form Offset: Between adjacent pieces of formwork, facing material shall not exceed 1/4 inch.
    c. Beams and Columns Tolerances:
        1) Exposed Straight Horizontal and Vertical Surfaces: Flat planes within tolerances specified.
        2) Lateral Alignment:
            a) Centerlines shall be within plus or minus 1/2 inch from dimensions shown.
            b) At intersections, centerlines shall intersect within plus or minus 1/2 inch of dimensions shown.
        3) Beam Type B-A:
            a) Physical Dimensions: Maximum 1/4 inch minus or 1/2 inch plus from dimension shown.
            b) Elevations: Within plus or minus 1/2 inch, except where tops of beams become part of finished slab. In this case refer to slab tolerances.

4) Column Type C-A:
   a) Physical Dimensions: Maximum 1/4 inch minus or 1/2 inch plus from dimension shown.
   b) Plumb within 1/4 inch in 10 feet in all directions with maximum 1/2 inch out-of-plumb at top with respect to bottom.

3.03 FORM REMOVAL

A. Nonsupporting forms, sides of beams, walls, columns, and similar parts of Work, may be removed after cumulatively curing at not less than 50 degrees F for 24 hours from time of concrete placement if:

1. Concrete is sufficiently hard so as not to sustain damage by form removal operations.
2. Curing and protection operations are maintained.

B. Elevated Structural Slabs or Beams: In accordance with ACI 318, Chapter 6, and at such time as concrete has reached compressive strength equal to 80 percent of specified 28-day compressive strength as determined by test cylinders.

C. Form Ties: Remove conical inserts or through bolts and plug holes as specified in Section 03 30 00, Cast-in-Place Concrete.

3.04 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 03 15 00
CONCRETE JOINTS AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A36/A36M, Specification for Carbon Structural Steel.
   b. A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   c. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   d. A767/A767M, Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
   e. C920, Specification for Elastomeric Joint Sealants.
   f. D226, Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
   g. D227, Specification for Coal-Tar Saturated Organic Felt Used in Roofing and Waterproofing.
   h. D994, Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
   i. D1056, Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
   j. D1171, Standard Guide for Evaluating Nonwoven Fabrics.
   k. D1751, Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
   l. D1752, Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
   m. D2240, Standard Test Method for Rubber Property – Durometer Hardness.
2. Corps of Engineers (COE): CRD-C-572, Corps of Engineers Specifications for Polyvinylchloride Waterstop.
3. NSF International (NSF): 61, Drinking Water System Components-Health Effects.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Waterstop: Details of splices, method of securing and supporting waterstop in forms to maintain proper orientation and location during concrete placement.
   b. Construction Joints, Expansion Joints and Control Joints: Layout and location for each type. Include joints locations shown on Drawings, additional required joint locations and any proposed alternate locations.
2. Product Data:
   a. Waterstops.
   b. Bond breaker.
   c. Premolded joint fillers.
   d. Pourable joint fillers.
   e. Roofing felt.
   f. Accessories not specified in other sections.
3. Samples: PVC waterstop splice, joint, and fabricated cross of each size, shape, and fitting of waterstop.

B. Informational Submittals:

1. Certification:
   a. Joint Filler(s) for Potable Water Structures: Confirmation material is certified to meet requirements of NSF 61.
   b. Letter stating compatibility between liquids being contained and materials used for:
      1) Waterstops.
      2) Joint fillers.
   c. Manufacturer’s application instructions for:
      1) Bonding agent.
      2) Bond breaker.
2. Manufacturer’s written instructions for product shipment, storage, handling, installation/application, and repair for:
   a. Waterstops.
   b. Bond breaker.
   c. Bonding agent.
   d. Premolded joint fillers.
   e. Pourable joint fillers (sealant proportions not required as products used only as a filler).

1.03 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site: Verify delivered materials are in accordance with Specifications, regulatory agencies, and Manufacturer's product data sheets prior to unloading and storing onsite.

B. Storage: Store materials under tarps to protect from oil, dirt, and sunlight or as required by Manufacturer.

PART 2 PRODUCTS

2.01 PLASTIC WATERSTOP

A. Extruded from elastomeric plastic compound of which basic resin shall be prime virgin polyvinyl chloride (PVC). Compound shall not contain scrapped material, reclaimed material, or pigment.

B. Specific Gravity: Approximately 1.37.

C. Shore Durometer Type A Hardness: Approximately 80.

D. Performance Requirements: COE Specification CRD-C-572.

E. Type Required in All Expansion, Contraction, and Control Joints: 6 inches wide or 9 inches wide with center bulb and parallel longitudinal ribs or protrusions on each side of strip center, as indicated on Drawings.

F. Type Required in Construction Joints: Flat ribbed, 6 inches wide or 9 inches wide with parallel longitudinal ribs or protrusions on each side of strip center. Center bulb is optional.

G. Corrugated or tapered type waterstops are not acceptable.

H. Thickness: Constant from bulb edge (or center of waterstop) to outside stop edge.

I. Minimum Weight per Foot of Waterstop:

1. 0.50 pound for 3/16 inch by 4 inches.
2. 1.60 pounds for 3/8 inch by 6 inches.
3. 2.30 pounds for 3/8 inch by 9 inches.

J. Factory Fabrications: Use only factory fabrications for intersections, transitions, and changes of direction.

K. Manufacturers and Products for Center Bulb Type:

1. Use same manufacturers for flat ribbed profile:
   a. Vinylex Corp., St Louis, MO.; No. RB638H (6 inches by 3/8 inch) and No. RB938H (9 inches by 3/8 inch).
   b. Greenstreak, St. Louis, MO; Style No. 702, (4 inches by 3/16 inch), Style 732 (6 inches by 3/8 inch) and Style 735 (9 inches by 3/8 inch).
   c. Durajoint, Garrettsville, OH.; Type 3, (4 inches by 3/16 inch,), Type 9 (6 inches by 3/8 inch), and Type 10 (9 inches by 3/8 inch).
   d. BoMetals, Carrollton, GA.: No. RCB-4316LB (4 inches by 3/16 inch), No. RCB-638LB (6 inches by 3/8 inch) and No. RCB-938NT (9 inches by 3/8 inch).
   e. Dacon Plastics LLC, Jacksonville, TX; No. RCB11, (4 inches by 3/16 inch), No. RCB17 (6 inches by 3/8 inch) and No. RCB18 (9 inches by 3/8 inch).

2.02 WIRE LOOPED PLASTIC WATERSTOP

A. Furnish as alternative to plastic waterstops.

B. Same material and geometry as plastic waterstops.

C. Furnish with continuous galvanized wire looping at edge for convenience in positioning and securing stop in place in forms.

D. Manufacturer and Product: Paul Murphy Plastics, Roseville, MI; “Wire Stop Waterstop,” geometry numbers ACR 6380, ACR 9380, as shown on Paul Murphy Plastics Co. Drawing No. CCP-120-12M.

2.03 HYDROPHILIC WATERSTOP

A. For use at construction joints only, where new concrete is placed against existing concrete and as shown on Drawings.

B. Material shall be a nonbentonite hydrophilic rubber compound.

C. Manufacturers and Products:

1. Greenstreak Plastic Products, St. Louis, MO; Hydrotite CJ-1020-2K with Leakmaster LV-1 adhesive and sealant.
2. Adeka Ultra Seal, JLM Associates, Spearfish, SD; MC-2010M with 3M-2141 adhesive and P-201 sealant.

2.04 BOND BREAKER

A. Tape for Joints: Adhesive-backed glazed butyl or polyethylene tape. Same width as joint that will adhere to premolded joint material or concrete surface.

B. Use bond prevention material as specified in Section 03 30 00, Cast-in-Place Concrete, except where bond breaker tape is specifically called for on Drawings.

2.05 PREMOLDED JOINT FILLER

A. Bituminous Type: ASTM D994 or ASTM D1751.

B. Sponge Rubber:

1. Neoprene, closed-cell, expanded; ASTM D1056, Type 2C5, with compression deflection, 25 percent deflection (limits), 119 kPa to 168 kPa (17 psi to 24 psi) minimum. Use in joints for potable and nonpotable water containment structures.
2. Manufacturer and Product: Monmouth Rubber and Plastics, Corp, Long Branch, NJ; Durafoam DK5151.

C. Self-Expanding Cork:

1. ASTM D1752, Type III.
2. Manufacturer and Product: WR Meadows, Inc., York, PA; self-expanding cork.

2.06 POURABLE JOINT FILLERS

A. General:

1. Although product is a sealant, it is being specified as a filler to prevent debris accumulation and allow expansion and contraction under shrinkage and thermal loads. It does not need to meet proportional sealant geometry requirements.
2. For Potable Water Containment structures, meet requirements of NSF 61.

B. Filler for Potable or Non-Potable Water Containment Structures:

1. Multicomponent sealant, self-leveling or nonsag as required for level, sloping, or vertical joints.
2. Color: White.
3. Manufacturer and Product: Sika Corp., Lyndhurst, NJ; Sikaflex-2c SL.

C. Filler for Nonpotable Water Containment Structures Only:

1. Pourable, two-component, cold-applied compound meeting ASTM C920, Type M, Grade P, Class 25, Use T.
2. Color: Black.
3. Manufacturer and Product: W.R. Meadows, Inc., Elgin, IL; Gardox.

2.07 ACCESSORIES

A. Joint Sealant: Polyurethane Type Sikaflex 2C, “or-equal.”

B. Roofing Felt: ASTM D226, Type II, 30-pound asphalt-saturated or equal weight of ASTM D227 coal-tar saturated felt.

C. Steel Reinforcement: As specified in Section 03 21 00, Steel Reinforcement.

D. Nails: Galvanized, as required for securing premolded joint filler.

E. Galvanized Rebar at Control Joints: ASTM A767/A767M and ASTM A615/A615M Grade 60 prior to galvanizing.

F. Ties for PVC Waterstop: “Hog Rings” or grommets for each edge at 12-inch maximum spacing.

PART 3 EXECUTION

3.01 GENERAL

A. Commence concrete placement after joint preparation is complete.

B. Time Between Concrete Pours: As specified in Section 03 30 00, Cast-in-Place Concrete.

C. Prestressed Reservoir Walls:

1. Horizontal construction joints are not permitted.
2. Vertical joints in addition to those shown may be used; meet design requirements for joints in walls.
3. As specified in Section 03 15 20, Concrete Wall Base and Top Joints.

3.02 SURFACE PREPARATION

A. Construction Joints: Prior to placement of abutting concrete, clean contact surface.

1. Remove laitance and spillage from steel reinforcement and dowels.
2. Roughen surface to minimum of 1/4-inch amplitude:
   a. Sandblast after concrete has fully cured.
   b. Water blast after concrete has partially cured.
   c. Green cut fresh concrete with high-pressure water and hand tools.
3. Perform cleaning so as not to damage waterstop, if one is present.

B. Expansion Joint:

1. Use wire brush or motorized device to mechanically roughen and thoroughly clean concrete surfaces on each side of joint from plastic waterstop to top of joint.
2. Use dry, high-pressure air to remove dust and foreign material, and dry joint.
3. Prime surfaces as required before placing joint filler.
4. Avoid damage to waterstop.

C. Contraction Joint and Control Joint:

1. Coat concrete surfaces above and below plastic waterstop with bond breaker.
2. Do not damage or coat waterstop.

D. Construction Joint with Hydrophilic Waterstop:

1. Follow hydrophilic waterstop manufacturer’s written instructions.
2. Clean debris, dirt, dust, and foreign material from concrete surface. Concrete surface must be smooth, clean, and dry. Grind concrete as required.

3.03 INSTALLATION OF WATERSTOPS

A. General:

1. Continuous waterstop shall be installed in all construction joints in walls and slabs of water holding basins and channels and in walls of belowgrade structures, unless specifically noted otherwise.
2. Join waterstop at intersections to provide continuous seal.
3. Center waterstop on joint.

4. Secure waterstop in correct position. Tie waterstop to steel reinforcement using grommets, “Hog Rings,” or tiewire at maximum spacing of 12 inches. Do not displace waterstop during concrete placement.
5. Repair or replace damaged waterstop.
6. Place concrete and vibrate to obtain impervious concrete in vicinity of joints.
7. Joints in Footings and Slabs:
    a. Ensure that space beneath horizontal waterstop is completely filled with concrete.
    b. During concrete placement, make visual inspection of waterstop area.
    c. Limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift ribbed waterstop to confirm full consolidation without voids, then place remaining concrete to full height of slab.

B. Plastic Waterstops:

1. Install in accordance with manufacturer’s written instructions.
2. Splice in accordance with waterstop manufacturer’s written instructions using Teflon-coated thermostatically controlled heating iron at approximately 380 degrees F.
    a. Allow at least 10 minutes before new splice is pulled or strained in any way.
    b. Finished splices shall provide cross section that is dense and free of porosity with tensile strength of not less than 80 percent of unspliced materials.
    c. Use only factory made waterstop fabrications for all intersections, changes of directions and transitions.
    d. Field splice permitted only for straight butt welds.
3. Wire looped plastic waterstop may be substituted for plastic waterstop.

C. Hydrophilic Waterstop:

1. Install in accordance with manufacturer’s written instructions.
2. Provide minimum of 2-1/2 inches of concrete cover over waterstop. When structure has two layers of steel reinforcement, locate centered between layers of steel or as shown.
3. Apply adhesive to concrete surface and allow to dry for specified time before applying waterstop strip.
4. Lap ends of waterstop strip together at splices and corners and join with sealant.

5. Verify that waterstop is anchored firmly in place before placing concrete. Do not allow vibrator to come into contact with waterstop.
6. Lap hydrophilic waterstop 2 feet minimum with intersecting plastic waterstops.

3.04 CONTRACTION JOINT INSTALLATION

A. Place bond breaker above and below waterstop.

B. Vibrate concrete thoroughly along the joint form to produce a dense, smooth surface. Do not roughen surface.

3.05 CONTROL JOINT INSTALLATION

A. Locate galvanized steel reinforcement as shown.

B. Install waterstop.

C. Vibrate concrete thoroughly along the joint form to produce a dense, smooth surface. Do not roughen surface.

D. Install bond breaker to concrete surfaces above and below waterstop.

3.06 MANUFACTURER’S SERVICES

A. Provide manufacturer’s representative at Site for installation assistance, inspection, and certification of proper installation for products specified.

3.07 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 03 15 20
CONCRETE WALL BASE AND TOP JOINTS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
   b. D2000, Standard Classification System for Rubber Products in Automotive Applications.
2. NSF International (NSF): 61, Drinking Water System Components-Health Effects.

1.02 SUBMITTALS

A. Action Submittals:

1. Product Data:
   a. Rubber pad.
   b. Sponge rubber.
2. Proposed method for holding projecting half of waterstop as wall concrete is placed.

B. Informational Submittals:

1. Manufacturer’s instructions for method of splicing of plastic waterstop.
2. Sealant for Sponge Rubber Filler: Manufacturer’s Certificate of Compliance in accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.01 MATERIALS

A. Plastic Waterstop: As specified in Section 03 15 00, Concrete Joints and Accessories.

B. Rubber Pad: Neoprene meeting ASTM D2000, Type M2 BC 414 A14C12F17.

1. Manufacturers:
   a. Dacon Industries Co., Portland, OR.
   b. West American Rubber Company, Inc., Orange, CA.

C. Sponge Rubber: Closed-cell, expanded neoprene meeting ASTM D1056, Type 2A5 with a compression deflection, 25 percent deflection (limits) 120 kPA to 170 kPA, (17 psi to 25 psi) minimum.

1. Manufacturers:
   a. Monmouth Rubber & Plastics Corp., Long Branch, NJ.
   b. Monarch Rubber Co., Baltimore, MD.

D. Sealant: Gun grade or pourable immersible sealant. Provide sealant certified by NSF and meeting the requirements of NSF 61 for use in contact with potable water.

1. Manufacturer and Product: Sika Chemical Co.; Sikaflex-1A or 2C.

PART 3 EXECUTION

3.01 INSTALLATION

A. Plastic Waterstop:

1. Continuous and as specified in Section 03 15 00, Concrete Joints and Accessories.
2. Field bond waterstop in wall base joint to waterstops in the wall vertical joint and slab or footing joints to form a continuous barrier capable of withstanding water pressure involved.
3. Make connections and splices required with field equipment capable of applying sufficient heat to bond the joint.
4. Method of Splicing: Butt splices in accordance with manufacturer’s instructions.
5. Completed splice shall develop strength of at least 80 percent of the strength of the continuous factory-molded strip.
6. Installation in Footings:
   a. Form footing so base of wall joint waterstop shall be continuously supported as concrete is placed.
   b. Position hollow-bulb section of waterstop in base of wall joint as shown on Drawings to vertical and horizontal tolerance of plus or minus 1/4 inch.

c. Field measure location of waterstop at base of wall using radial measurements from reservoir center to guarantee waterstop is located and placed in a true circle over its entire length.
d. Install a continuous circular form to secure the waterstop to final shape and position.
e. Carefully screed and trowel concrete surface within area to be occupied by the wall to provide a uniform bearing surface for rubber pads.
f. Grind or repair surface irregularities that may interfere with the required action of joint.
g. Prepared Surface Tolerance: Not to exceed 1/8 inch in 10 feet.
h. Provide approved means to ensure support of the projecting half of the waterstop as wall concrete is placed, to prevent out-of-tolerance movement and location due to concrete pressure or other construction loads that might be placed on waterstop.

B. Seismic Cables: Located and install as shown on Drawings and as specified in Section 05 16 34, Seismic Cabling.

C. Rubber Pad:

1. Place between wall and base slab and between wall and roof slab as shown on Drawings.
2. Prior to cementing rubber pad or sponge rubber in place, dry concrete surface and brush thoroughly to remove dirt and foreign material.
3. Use waterproof rubber cement or glue that will not damage pad to bond rubber to concrete surface.
4. Caulk between waterstop and rubber pad with sealant that will remain in place to ensure fresh concrete or mortar does not penetrate below top of rubber pad. Seal gaps that would allow concrete from wall pour to penetrate pad area and cause local spalling.

D. Sponge Rubber:

1. Place to preclude concrete-to-concrete bearing between wall and base slab and between wall and roof slab.
2. Caulk crevices in the trimmed sponge rubber with sealant that will remain in place to ensure fresh concrete or mortar does not penetrate below top of neoprene pad or sponge rubber pads.
3. Support edges of sponge rubber pieces and strips:
   a. To restrain surfaces from movement during concrete placement.
   b. To reduce load deflection of sponge rubber under weight of fresh concrete to a minimum.
4. Protect during initial concrete placement to prevent movement of sponge rubber from vibration, falling concrete, and other forces.

5. Prior to horizontal prestressing or filling of tank, clean face of joints of concrete and mortar so sponge rubber is seen at full depth and joint is free from concrete or other material that would restrict or prevent wall movement and cause local spalling.

3.02 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 03 21 00
STEEL REINFORCEMENT

PART 1 GENERAL

1.01 GENERAL

A. Steel reinforcement shall comply with ACI 301 and as modified in the following.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 117, Specification for Tolerances for Concrete Construction and Materials.
   b. 301, Specifications for Structural Concrete.
   c. SP-66, Detailing Manual.
2. American Welding Society (AWS): D1.4/D1.4M, Structural Welding Code - Reinforcing Steel.
3. ASTM International (ASTM):
   a. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   b. A706/A706M, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
   c. A767/767M, Standard Specification for Zinc-Coated (Galvanized) Steel bars for Concrete Reinforcement.
   d. A1064/A1064M, Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
4. Concrete Reinforcing Steel Institute (CRSI):
   a. Placing Reinforcing Bars.
   b. Manual of Standard Practice.
5. International Code Council (ICC): Evaluation Services Report.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings prepared in accordance with ACI 301 and ACI SP-66:
   a. Bending lists.
   b. Placing drawings.
2. Welded, metallic sleeve splice, and mechanical threaded connection.

B. Informational Submittals:

1. Lab test reports for steel reinforcement showing stress-strain curves and ultimate strengths.
2. Mechanical Threaded Connections:
   a. Current ICC Evaluation Services Report or equivalent code agency report listing findings to include acceptance, special inspection requirements, and restrictions.
   b. Verification device threads have been tested and meet requirements for thread quality, in accordance with manufacturer's published methods.
   c. Manufacturer's instructions.
3. Welding Qualification: Prior to welding, submit welder qualifications and nondestructive testing procedures.
4. Test results of field testing.

1.04 QUALITY ASSURANCE

A. Welder Qualifications: Certified in accordance with AWS D1.4/D1.4M.

1.05 DELIVERY, STORAGE, AND HANDLING

A. In accordance with ACI 301 and recommendations of CRSI Placing Reinforcing Bars.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing Bars:

1. Includes stirrups, ties, and spirals.
2. ASTM A615/A615M, Grade 60, where welding is not required.
3. ASTM A706/A706M, Grade 60, for reinforcing to be welded.
4. ASTM A767/767M, Grade 60, for galvanized bars.

B. Mechanical Splices and Connections:

1. Metal Sleeve Splice:
   a. Furnish with cast filler metal, capable of developing, in tension or compression, 125 percent of minimum tensile strength of bar.
   b. Manufacturer and Product: Erico Products, Inc., Cleveland, OH; Cadweld T-Series.

2. Mechanical Threaded Connections:
   a. Furnish metal coupling sleeve with internal threads engaging threaded ends of bars developing in tension or compression 125 percent of yield strength of bar.
   b. Manufacturers and Products:
      1) Erico Products, Inc., Cleveland, OH; Lenton Reinforcing Steel Couplers.
      2) Erico Products, Inc., Cleveland, OH; Lenton Lock Mechanical Rebar Splicing System.
      3) Richmond Screw Anchor Co., Inc., Fort Worth, TX; Richmond DB-SAE Dowel Bar Splicers.

2.02 ACCESSORIES

A. Tie Wire:

1. Black, soft-annealed 16-gauge wire.
2. Nylon-, epoxy-, or plastic-coated wire.

B. Bar Supports and Spacers:

1. Use precast concrete bar supports or all-plastic bar supports and side form spacers, unless noted otherwise. Do not use other types of supports or spacers.
2. Bar supports shall have sufficient strength and stiffness to carry loads without failure, displacement, or significant deformation. Space bar supports so minimum concrete cover is maintained for reinforcing between supports.
3. Use only precast concrete bar supports where concrete surfaces are exposed to weather, earth, water, chloride intrusion, or corrosive chemicals. Bar supports shall be nonconductive and have geometry and bond characteristics that deter movement of moisture from the surface to the reinforcement.
4. Precast concrete supports shall have same minimum strength and shall be made from same materials as that of the concrete in which they are to be embedded. Precast concrete supports shall be cast and properly cured for at least 7 days before use and shall have a wire or other device cast into each block for the purpose of attaching them securely to steel reinforcement.
5. In Beams, Columns, Walls, and Slabs Exposed to View after Form Removal: Use small precast concrete blocks made of same color as concrete in which they are embedded. All-plastic bar supports and side form spacers may be used, except where surface is exposed as described above.

6. Design and fabricate special bar supports for top reinforcing bars in slabs where standard bar supports do not possess necessary geometry, strength, or stiffness.
7. Plastic Bar Supports: Manufactured by Aztec Concrete Accessories, Bloomington, CA.
8. Precast Concrete Supports: Total bond precast, high-performance concrete bar supports as supplied by Dayton Superior, Miamisburg, OH, Dobies.

PART 3 EXECUTION

3.01 PREPARATION

A. Notify Engineer when reinforcing is ready for inspection and allow sufficient time for inspection prior to placing concrete.

B. Clean reinforcing bars of loose mill scale, oil, earth, and other contaminants.

3.02 INSTALLATION

A. Bundle or space bars, instead of field bending where construction access through reinforcing is necessary.

B. Splicing:

1. Minimum length of lap splices shall comply with table in Contract Documents.
2. Use lap splices, unless otherwise shown or permitted in writing by Engineer.
3. Welded Splices: Accomplish by full penetration groove welds and develop a minimum of 125 percent of yield strength of bar.
4. Stagger splices in adjacent bars where indicated.

C. Mechanical Splices and Connections:

1. Use only in areas specifically approved in writing by Engineer.
2. Install threaded rods as recommended by manufacturer with threads totally engaged into coupling sleeve and in accordance with ICC Evaluation Services Report or equivalent code agency report.
3. For metal sleeve splice, follow manufacturer’s installation recommendations.
4. Maintain minimum edge distance and concrete cover.

D. Tying Reinforcing Bars:

1. Tie every other intersection on mats made up of No. 3, No. 4, No. 5, and No. 6 bars to hold them firmly at required spacing.
2. Bend tie wire away from concrete surface to provide clearance of 1 inch from surface of concrete to tie wire.

E. Reinforcement Around Openings: On each side and above and below pipe or opening, place an equivalent area of steel bars to replace steel bars cut for opening. Extend steel reinforcing a standard lap length beyond opening at each end.

F. Welding Reinforcement:

1. Only ASTM A706/A706M bars may be welded.
2. Do not perform welding until welder qualifications are approved.

G. Straightening and Rebending: Field bending of steel reinforcement bars is not permitted.

H. Unless permitted by Engineer, do not cut reinforcing bars in field.

3.03 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 117, Specification for Tolerances for Concrete Construction and Materials.
   b. 301, Specifications for Structural Concrete.
   c. 305.1, Specification for Hot Weather Concreting.
   d. 306.1, Standard Specification for Cold Weather Concreting.
   e. 350.1, Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures.
   f. CP-1, Technical Workbook for ACI Certification of Concrete Field Testing Technician – Grade 1.
2. ASTM International (ASTM):
   a. C31/C31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   b. C33/C33M, Standard Specification for Concrete Aggregates.
   c. C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   d. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   e. C109/C109M, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
   f. C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete.
   g. C150/C150M, Standard Specification for Portland Cement.
   h. C157/C157M, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
   i. C227, Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).
   j. C231/C231M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
   k. C260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.
   l. C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
   m. C595/C595M, Standard Specification for Blended Hydraulic Cements.

n. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
o. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
p. C979/C979M, Standard Specification for Pigments for Integrally Colored Concrete.
q. C989, Standard Specification for Slag Cement for Use in Concrete and Mortars.
r. C1012/C1012M, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.
s. C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
t. C1074, Standard Practice for Estimating Concrete Strength by the Maturity Method.
u. C1077, Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.
v. C1218/C1218M, Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
w. C1240, Standard Specification for Silica Fume Used in Cementitious Mixtures.
x. C1260, Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
y. C1293, Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
z. C1567, Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
aa. C1582/C1582M, Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete.
bb. C1602/C1602M, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
cc. D4580, Standard Practice for Measuring Delaminations in Concrete Bridge Decks by Sounding.
dd. E329, Standard Specification for Agencies Engaged in Construction Inspection, Special Inspection, or Testing Materials Used in Construction.
ee. E1155, Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers.

3. National Ready Mixed Concrete Association (NRMCA).

1.02 DEFINITIONS

A. Basin Train: Series of interconnected basins that operate as a unit with same water level.

B. Cold Weather: When ambient temperature is below 40 degrees F or is approaching 40 degrees F and falling.

C. Contractor's Licensed Design Engineer: Individual representing Contractor who is licensed to practice engineering as defined by statutory requirements of professional licensing laws in state or jurisdiction in which Project is to be constructed.

D. Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4-inch in diameter, cracks in liquid containment structures and below grade habitable spaces that are 0.005-inch wide and wider, and cracks in other structures that are 0.010-inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections. At exposed concrete, defective areas also include texture irregularities, stains, and other color variations that cannot be removed by cleaning.

E. Exposed Concrete: Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when structure is drained.

F. Hot Weather: As defined in ACI 305.1.

G. Hydraulic Structure: Liquid containment structure.

H. New Concrete: Less than 60 days old.

I. Slurry Mixture: Mixture of sand, 3/8-inch maximum nominal aggregate size, cement, and water for wall construction joints with waterstop.

1.03 SUBMITTALS

A. Action Submittals:

1. Mix Designs:
   a. Contain proportions of materials and admixtures to be used on Project, signed by mix designer.
   b. Documentation of average strength for each proposed mix design in accordance with ACI 301.

c. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for the following:
   1) Portland cement.
   2) Fly ash.
   3) Slag cement.
   4) Aggregates, including specified class designation for coarse aggregate.
   5) Admixtures.
   6) Concrete producer has verified compatibility of constituent materials in design mix.

d. Test Reports:
   1) Water-Soluble Chloride-Ion Content in Hardened Concrete: Unless otherwise permitted, in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.
   2) Shrinkage Test Results: In accordance with ASTM C157/C157M as modified herein.

e. Aggregates:
   1) Coarse Aggregate Gradation: List gradings and percent passing through each sieve.
   2) Fine Aggregate Gradation: List gradings and percent passing through each sieve.
   3) Percent of fine aggregate weight to total aggregate weight.
   4) Deleterious substances in fine aggregate per ASTM C33/C33M, Table 2.
   5) Deleterious substances in coarse aggregate per ASTM C33/C33M, Table 4.
   6) Test Reports:
      a) Alkali Aggregate Reactivity: Aggregate shall be classified as nonpotentially reactive in accordance with Article Concrete Mix Design. Include documentation of test results per applicable standards.

f. Admixtures: Manufacturer's catalog cut sheets and product data sheets for each admixture used in proposed mix designs.

2. Product Data: Specified ancillary materials.
3. Detailed plan for curing and protection of concrete placed and cured in cold weather. Details shall include, but not be limited to, the following:
   a. Procedures for protecting subgrade from frost and accumulation of ice or snow on reinforcement, other metallic embeds, and forms prior to placement.
   b. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.
   c. Methods for temperature protection during placement.

d. Types of covering, insulation, housing, or heating to be provided.
e. Curing methods to be used during and following protection period.
f. Use of strength accelerating admixtures.
g. Methods for verification of in-place strength.
h. Procedures for measuring and recording concrete temperatures.
i. Procedures for preventing drying during dry, windy conditions.

4. Detailed plan for hot weather placements including curing and protection for concrete placed in ambient temperatures over 80 degrees F. Plan shall include, but not be limited to, the following:
   a. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.
   b. Use of retarding admixture.
   c. Methods for controlling temperature of reinforcement and other embedded items and concrete materials before and during placement.
   d. Types of shading and wind protection to be provided.
   e. Curing methods, including use of evaporation retardant.
   f. Procedures for measuring and recording concrete temperatures.
   g. Procedures for preventing drying during dry, windy conditions.
5. Concrete repair techniques.

B. Informational Submittals:

1. Preinstallation Conference minutes.
2. Manufacturer’s application instructions for bonding agent and bond breaker.
3. Manufacturer’s Certificate of Compliance to specified standards:
   a. Bonding agent.
   b. Bond breaker.
   c. Repair materials.
4. Statement of Qualification:
   a. Batch Plant: Certification as specified herein.
   b. Mix designer.
   c. Installer.
   d. Testing agency.
5. Field test reports.
6. Tightness test results.
7. Concrete Delivery Tickets:
   a. For each batch of concrete before unloading at Site.
   b. In accordance with ASTM C94/C94M, including requirements 14.2.1. through 14.2.10.
   c. Indicate amount of mixing water withheld and maximum amount that may be permitted to be added at Site.

1.04 QUALITY ASSURANCE

A. Concrete construction shall conform to requirements of ACI 117 and ACI 301, except as modified herein.

B. Qualifications:

1. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
2. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work. Requirement may be waived if individual is Contractor's Licensed Design Engineer.
3. Testing Agency: Unless otherwise permitted, an independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
    a. Where field testing is required of Contractor, personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
    b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

C. Preinstallation Conference:

1. Required Meeting Attendees:
    a. Contractor, including pumping, placing and finishing, and curing subcontractors.
    b. Ready-mix producer.
    c. Admixture representative.
    d. Testing and sampling personnel.
    e. Engineer who authored Statement of Special Inspection Plan or Engineer's designee.
2. Schedule and conduct prior to incorporation of respective products into Project. Notify Engineer of location and time.
3. Agenda shall include:
    a. Admixture types, dosage, performance, and redosing at Site.
    b. Mix designs, test of mixes, and Submittals.
    c. Placement methods, techniques, equipment, consolidation, and form pressures.
    d. Slump and placement time to maintain slump.
    e. Finish, curing, and water retention.

f. Protection procedures for weather conditions.
g. Other specified requirements requiring coordination.

4. Conference minutes as specified in Section 01 31 19, Project Meetings.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cementitious Materials:

1. Cement:
   a. Portland Cement: Unless otherwise specified, conform to requirements of ASTM C150/C150M.
   b. Blended Hydraulic Cement:
      1) Unless otherwise specified, conform to requirements of ASTM C595/C595M.
      2) Portland Cement used in blended hydraulic cement, conform to requirements of ASTM C150/C150M.
   c. Furnish from one source.
2. Supplementary Cementitious Materials (SCM):
   a. Fly Ash (Pozzolan): Class F fly ash in accordance with ASTM C618, except as modified herein:
      1) ASTM C618, Table 1, Loss on Ignition: Unless permitted otherwise, maximum 3 percent.
   b. Slag Cement: In accordance with ASTM C989, Grade 100 or Grade 120.

B. Aggregates: Unless otherwise permitted, furnish from one source for each aggregate type used in a mix design.

1. Normal-Weight Aggregates:
   a. In accordance with ASTM C33/C33M, except as modified herein.
      1) Class Designation: 4S unless otherwise specified.
   b. Free of materials and aggregate types causing popouts, discoloration, staining, or other defects on surface of concrete.
   c. Alkali Silica Reactivity: See Article Concrete Mix Design.
2. Fine Aggregates:
   a. Clean, sharp, natural sand.
   b. ASTM C33/C33M.
   c. Limit deleterious substances in accordance with ASTM C33/C33M, Table 2 and as follows:
      1) Limit material finer than 75-µm (No. 200) sieve to 3 percent mass of total sample.
      2) Limit coal and lignite to 0.5 percent.

3. Coarse Aggregate:
    a. Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).
    b. Limit deleterious substances in accordance with ASTM C33/C33M, Table 4 for specified class designation.

C. Admixtures: Unless otherwise permitted, furnish from one manufacturer.

1. Characteristics:
    a. Compatible with other constituents in mix.
    b. Contain at most, only trace amount chlorides in solution.
    c. Do not use admixtures known to be toxic after concrete is 30 days.
    d. Furnish type of admixture as recommended by manufacturer for anticipated temperature ranges.
2. Air-Entraining Admixture: ASTM C260/C260M.
3. Water-Reducing Admixture: ASTM C494/C494M, Type A or Type D.
4. Retarding Admixture: ASTM C 494/C 494M, Type B.
5. Accelerating Admixture: ASTM C 494/C 494M, Type C.
6. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F or Type G.
7. Shrinkage Reducing Admixture:
    a. Manufacturers and Products:
        1) BASF Admixtures Inc., Shakopee, MN; Tetraguard AS20.
        2) Euclid Chemical Co., Cleveland, OH; Eucon SRA Series.
        3) W. R. Grace & Co., Cambridge, MA; Eclipse Series.
8. Do not use calcium chloride as an admixture.
9. Admixtures with no standard, ASTM or other, designation may be used where permitted.

D. Water and Ice: Mixing water for concrete and water used to make ice shall be potable water, unless alternative sources of water are permitted.

1. Water from alternative sources shall comply with requirements of ASTM C1602/C1602M, and concentration of chemicals in combined mixing water shall be less than:
    a. Chloride Content: 500 ppm.
    b. Sulfate Content as SO_4: 3,000 ppm.
    c. Alkalis as (Na_2O + 0.658 K_2O): 600 ppm.
    d. Total Solids by Mass: Less than 50,000 ppm.

2.02 ANCILLARY MATERIALS

A. Bonding Agent: Unless otherwise specified, in accordance with the following:

1. ASTM C881/C881M, Type V.
2. Two-component, moisture insensitive, 100 percent solids epoxy.
3. Consult manufacturer for surface finish, pot life, set time, vertical or horizontal application, and forming restrictions.

B. Bond Breaker:

1. Nonstaining type, providing positive bond prevention.
2. Manufacturers and Products:
   a. Dayton Superior Corporation, Kansas City, KS; EDOCO Clean Lift Bond Breaker.
   b. Nox-Crete Products Group, Omaha, NE; Silcoseal Select.

C. Repair Material:

1. Contain only trace amounts of chlorides and other chemicals that can potentially cause steel to oxidize.
2. Where repairs of exposed concrete are required, prepare mockup using proposed repair materials and methods, for confirmation of appearance compatibility prior to use.
3. Obtain Manufacturer’s Certificate of Compliance that products selected are appropriate for specific applications.
4. Repair mortar shall be site mixed.
5. Prepare concrete substrate and mix, place, and cure repair material in accordance with manufacturer’s written recommendations.
6. Manufacturers and Products:
   a. BASF Building Systems Inc., Shakopee, MN; EMACO S-Series products.
   b. Sika Chemical Corp., Lyndhurst, NJ; SikaTop-Series.

D. Crack Repair: In accordance with requirements of Section 03 64 23, Epoxy Resin Injection Grouting.

2.03 CONCRETE MIX DESIGN

A. General:

1. See Supplement at the end of this section for mix design requirements for each class of concrete used on Project.
2. Prepare design mixtures for each type and strength of concrete, selecting and proportioning ingredients in accordance with requirements of ACI 301, unless otherwise specified.

3. Selection of constituent materials and products in mix design are optional, unless specified otherwise.
4. Unless otherwise permitted, use water-reducing admixture or water-reducing admixture and high-range, water-reducing admixture in pumped concrete, in concrete with a water-cementitious materials ratio below 0.50, and in concrete that is part of a liquid-containment structure.
5. Unless otherwise permitted, use water-reducing admixture and high-range, water-reducing admixture in columns, piers, pilasters, and walls.
6. Use water-reducing admixture or high-range, water-reducing admixture to achieve fresh properties that facilitate handling, placing, and consolidating of concrete, and specified hardened properties.
7. Use water-reducing and retarding admixture when anticipated high temperatures, low humidity, or other adverse placement conditions can adversely affect fresh properties of concrete.
8. Unless otherwise specified, desired fresh properties of concrete shall be determined by Contractor and coordinated with concrete producer. Fresh properties of concrete shall remain stable to satisfaction of Contractor, for duration of placement and consolidation, and shall remain in conformance with requirements of Contract Documents.
9. Contractor is encouraged to consider using environmentally sustainable concrete mix design technologies.

B. Potential Alkali-aggregate Reactivity of Concrete:

1. Do not use aggregates known to be susceptible to alkali-carbonate reaction (ACR).
2. Aggregates shall have been tested to determine potential alkali-aggregate reactivity in concrete in accordance with ASTM C1260 or ASTM C1567.
    a. Aggregates that indicate expansion greater than 0.10 percent at 16 days after casting shall not be used unless they have been shown to be nondeleteriously reactive in accordance with ASTM C227 or ASTM C1293, with less than 0.04 percent expansion at 1 year for cement-aggregate combinations or less than 0.04 percent expansion at 2 years for combinations with pozzolan or slag.
    b. Alkali content of cement used in proposed concrete mixture shall not be greater than alkali content of cement used in test for potential alkali-aggregate reactivity.
    c. Use low-alkali cement or incorporate pozzolans into concrete mixture as necessary to satisfy testing for potential alkali reactivity. Alternately, a chemical inhibitor such as a lithium based admixture may be proposed.

C. Proportions:

1. Design mix to meet aesthetic, durability, and strength requirements.
2. Where fly ash is included in mix, minimum fly ash content shall be a minimum of 15 percent of weight of total cementitious materials.

D. Concrete Shrinkage Limits:

1. Where shrinkage limits are specified, design mix for following shrinkage limits and test in accordance with ASTM C157/C157M, with the following modifications:
   a. Prisms shall be moist cured for 7 days prior to 28-day drying period.
   b. Comparator reading at end of 7-day moist cure shall be used as initial length in length change calculation.
   c. Reported results shall be average of three prisms.
   d. If shrinkage of a specimen departs from average of that test age by more than 0.004 percent, disregard results obtained from that specimen.
   e. Unless otherwise specified, results at end of 28-day drying period shall not exceed 0.040 percent if 3-inch prisms are used or exceed 0.038 percent if 4-inch prisms are used. Aggregate will be rejected if test values exceed these limits.

E. Slump Range at Site:

1. Prior to submitting mix design, consult with concrete producer and select a target slump value at point of delivery, for each application of each design mix. Unless otherwise permitted, target slump value will then be enforced for duration of Project.
2. Design mixes that include a high-range, water-reducing admixture shall have a minimum slump of 2 inches prior to addition of admixture. Unless otherwise permitted, slump shall be 8 inches maximum at point of delivery, for concrete with a high-range, water-reducing admixture.
3. Slump tolerance shall meet requirements of ACI 117.

F. Combined Aggregate Gradation:

1. Combined Gradation Limits: Fine aggregate shall be in range of 36 percent to 40 percent of total aggregate weight.

2.04 CONCRETE MIXING

A. General: In accordance with ACI 301, except as modified herein.

B. Truck Mixers:

1. For every truck, test slump of samples taken per ASTM C94/C94M, Paragraph 12.5.1.
2. Where specified slump is more than 4 inches, and if slump tests differ by more than 2 inches, discontinue use of truck mixer, unless causing condition is corrected and satisfactory performance is verified by additional slump tests.

2.05 SOURCE QUALITY CONTROL

A. Source Quality Control Inspection: Engineer shall have access to and have right to inspect batch plants, cement mills, and supply facilities of suppliers, manufacturers, and Subcontractors, providing products included in this section.

PART 3 EXECUTION

3.01 PLACING CONCRETE

A. Preparation: Meet requirements ACI 301, except as modified herein.

B. Inspection: Notify Engineer and Special Inspector at least 1 full working day in advance before starting to place concrete.

C. Placement into Formwork:

1. Reinforcement: Secure in position before placing concrete.
2. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 1.5 feet deep, except for slabs which shall be placed full depth. Place and consolidate successive layers prior to initial set of first layer to prevent cold joints.
3. Placement frequency shall be such that lift lines will not be visible in exposed concrete finishes.
4. Use placement devices, for example chutes, pouring spouts, and pumps as required to prevent segregation.
5. Vertical Free Fall Drop to Final Placement:
    a. Forms 8 Inches or Less Wide: 5 feet.
    b. Forms Wider than 8 Inches: 8 feet, except as specified.

6. For placements where drops are greater than specified, use placement device such that free fall below placement device conforms to required value. Limit free fall to prevent segregation caused by aggregates hitting steel reinforcement.
7. Do not use aluminum conveying devices.
8. Provide sufficient illumination in the interior of forms so concrete deposition is visible, permitting confirmation of consolidation quality.
9. Joints in Footings and Slabs:
    a. Ensure space beneath plastic waterstop completely fills with concrete.
    b. During concrete placement, make visual inspection of entire waterstop area.
    c. Limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, and place remaining concrete to full height of slab.
    d. Apply procedure to full length of waterstop.
10. Trowel and round off top exposed edges of walls with 1/4-inch radius steel edging tool.
11. Cure concrete as specified in Section 03 39 00, Concrete Curing.

D. Conveyor Belts and Chutes:

1. Design and arrange ends of chutes, hopper gates, and other points of concrete discharge throughout conveying, hoisting, and placing system for concrete to pass without becoming segregated.
2. Do not use chutes longer than 50 feet.
3. Minimum Slopes of Chutes: Angled to allow concrete to readily flow without segregation.
4. Conveyor Belts:
    a. Approved by Engineer.
    b. Wipe clean with device that does not allow mortar to adhere to belt.
    c. Cover conveyor belts and chutes.

E. Retempering: Not permitted for concrete where cement has partially hydrated.

F. Pumping of Concrete:

1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to ensure completion of concrete placement without cold joints in case of primary placing equipment breakdown.
2. Minimum Pump Hose (Conduit) Diameter: 4 inches.
3. Replace pumping equipment and hoses (conduits) that are not functioning properly.

G. Maximum Size of Concrete Placements:

1. Limit size of each placement to allow for strength gain and volume change as a result of shrinkage.
2. Locate expansion, control, and contraction joints where shown on Drawings.
3. Construction Joints: Unless otherwise shown or permitted, locate construction joints as follows:
    a. Locate construction joints as shown on Drawings or where approved in joint location submittal required in Section 03 15 00, Concrete Joints and Accessories.
    b. Provide vertical construction joints in walls and slabs at maximum spacing of 40 feet, unless shown or approved otherwise.
    c. When vertical expansion, contraction, or control joint spacing does not exceed 60 feet, intermediate construction joints are not required.
    d. Uniformly space vertical construction joints within straight sections of walls and slabs, avoiding penetrations.
4. Consider beams, girders, brackets, column capitals, and haunches as part of floor or roof system and place monolithically with floor or roof system.
5. Should placement sequence result in cold joint located below finished water surface, install waterstop in joint.

H. Minimum Time between Adjacent Placements:

1. Construction Joint: As soon as can safely be done without damaging previously cast concrete or interrupting curing thereof, but not less than 24 hours.
2. Expansion or Contraction Joints: 1 day.
3. For columns and walls with a height in excess of 10 feet, wait at least 2 hours before depositing concrete in beams, girders, or slabs supported thereon.
4. For columns and walls 10 feet in height or less, wait at least 1 hour prior to depositing concrete in beams, girders, brackets, column capitals, or slabs supported thereon.

I. Consolidation and Visual Observation:

1. Consolidation Equipment and Methods: ACI 301.
2. Provide at least one standby vibrator in operable condition at Site prior to placing concrete.

3. Provide sufficient windows in forms or limit form height to allow for concrete placement through windows and for visual observation of concrete.
4. Vibrate concrete in vicinity of joints to obtain impervious concrete.

J. Hot Weather:

1. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 301, ACI 305.1, and as follows:
   a. Maintain concrete temperature below 95 degrees F at time of placement or furnish test data or other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.
   b. Provide for windbreaks, shading, fog spraying, sprinkling, ice, wet cover, or other means as necessary to maintain concrete at or below specified temperature.
2. Concrete Curing: As specified in Section 03 39 00, Concrete Curing.

K. Cold Weather Placement:

1. Unless otherwise permitted, shall be in accordance with requirements of ACI 306.1 and as follows:
   a. Cold weather requirements shall apply when ambient temperature is below 40 degrees F or approaching 40 degrees F and falling.
   b. Do not place concrete over frozen earth or against surfaces with frost or ice present. Frozen earth shall be thawed to acceptance of Engineer.
   c. Unless otherwise permitted, do not place concrete in contact with surfaces less than 35 degrees F; requirement is applicable to all surfaces including reinforcement and other embedded items.
   d. Provide supplemental external heat as needed when other means of thermal protection are unable to maintain minimum surface temperature of concrete as specified in ACI 306.1.
   e. Maintain minimum surface temperature of concrete as specified in ACI 306.1 for no less than 3 days during cold weather conditions.
   f. Cure concrete as specified in Section 03 39 00, Concrete Curing. Protect concrete from freezing until end of curing period and until concrete has attained a compressive strength of 3,500 psi or design compressive strength if less than 3,500 psi.

2. Provide maximum and minimum temperature sensors placed on concrete surfaces spaced throughout Work to allow monitoring of concrete surface temperatures representative of Work. Unless otherwise permitted, record surface temperature of concrete at least once every 12 hours during specified curing period.
3. External Heating Units: Do not exhaust heater flue gases directly into enclosed area as it causes concrete carbonation as a result of concentrated carbon dioxide.
4. Maintain curing conditions as specified in Section 03 39 00, Concrete Curing.

3.02 CONCRETE BONDING

A. Construction Joints in New Concrete Members:

1. Prepare surface of construction joint as specified in Section 03 15 00, Concrete Joints and Accessories.
2. Horizontal Construction Joints Containing Waterstop in New Concrete Walls:
   a. Unless otherwise permitted, place slurry mixture 4-inch maximum thickness, 2-inch minimum thickness in horizontal construction joints containing waterstops.
   b. Use positive measuring device such as bucket or other device that will contain only enough slurry mixture for depositing in visually measurable area of wall to ensure that portion of form receives appropriate amount of slurry mixture to satisfy placement thickness requirements.
   c. Do not deposit slurry mixture from pump hoses or large concrete buckets, unless specified placement thickness can be maintained and verified through inspection windows close to joint, or by other means.
   d. Limit concrete placed immediately on top of slurry mixture to 12 inches thick. Thoroughly vibrate to mix concrete and slurry mixture together.

B. Construction Joints at Existing Concrete (includes hardened New Concrete):

1. Thoroughly clean and mechanically roughen existing concrete surfaces to roughness profile of 1/4-inch.
2. Saturate surface with water for 24 hours prior to placing new concrete.

3.03 REPAIRING CONCRETE

A. General:

1. Inject cracks that leak with crack repair epoxy as specified in Section 03 64 23, Epoxy Resin Injection Grouting.
2. Repair defective areas of concrete.
3. Repair concrete surfaces using specified materials. Select system, submit for review, and obtain approval from Engineer prior to use.
4. Develop repair techniques with material manufacturer on surface that will not be visible in final construction or on mockup panels prior to starting actual repair work and show how finish color will blend with adjacent surfaces. Obtain approval from Engineer.
5. Obtain quantities of repair material and manufacturer's detailed instructions for use to provide repair with finish to match adjacent surface or apply sufficient repair material adjacent to repair to blend finish appearance.
6. Repair of concrete shall provide structurally sound surface finish, uniform in appearance or upgrade finish by other means until acceptable to Engineer.

B. Tie Holes: Unless otherwise specified, fill with specified repair material. Prepare substrate and mix, place, and cure repair material per manufacturer's written recommendations.

C. Alternate Form Ties, Through-Bolts:

1. Mechanically roughen entire interior surface of through hole.
2. Apply bonding agent to roughened surface and drive elastic vinyl plug to half depth.
3. Dry pack entire hole from both sides of plug with nonshrink grout, as specified in Section 03 62 00, Nonshrink Grouting.
4. Use only enough water to dry pack grout.
5. Dry pack while bonding agent is still tacky.
6. If bonding agent has dried, remove bonding agent by mechanical means and reapply new coat of bonding agent.
7. Compact grout using steel hammer and steel tool to drive grout to high density.
8. Cure grout with water.

D. Exposed Metal Objects:

1. Remove metal objects not intended to be exposed in as-built condition of structure including wire, nails, and bolts, by chipping back concrete to depth of 1 inch and then cutting or removing metal object.
2. Repair area of chipped-out concrete as specified for defective areas.

E. Blockouts at Pipes or Other Penetrations: Where shown install in accordance with requirements of Drawings.

3.04 CONCRETE WALL FINISHES

A. Type W-1 (Ordinary Wall Finish):

1. Patch tie holes.
2. Knock off projections.
3. Repair defective areas.
4. Inject cracks in accordance with requirements of Section 03 64 23, Epoxy Resin Injection Grouting.

B. Type W-2 (Smooth Wall Finish):

1. Patch tie holes.
2. Grind off fins and other projections.
3. Repair defective areas to provide smooth uniform appearance.
4. Inject cracks in accordance with requirements of Section 03 64 23, Epoxy Resin Injection Grouting.

C. Type W-6 (Finish for Prestressed Tanks):

1. Remove form ridges, pieces of wood, and excess concrete from formed surfaces same day forms are removed.
2. If forms are removed within 7 days of placement, minimize interruption of curing.
3. In accordance with requirements for Type W-2 except as follows:
   a. Sandblast core wall exterior surface.
   b. Exposed edge of roof shall have Type W-5 finish.

3.05 CONCRETE SLAB FINISHES

A. General:

1. Use manual screeds, vibrating screeds, or roller compacting screeds to place concrete level and smooth.
2. Do not use “jitterbugs” or other special tools designed for purpose of forcing coarse aggregate away from surface and allowing layer of mortar, which will be weak and cause surface cracks or delamination, to accumulate.
3. Finish slab in accordance with specified slab finish.
4. Do not dust surfaces with dry materials nor add water to surfaces.
5. Cure concrete as specified in Section 03 39 00, Concrete Curing.

B. Type S-1 (Steel Troweled Finish):

1. Finish by screeding and floating with straightedges to bring surfaces to required finish elevation.
2. Wood float to true, even plane with no coarse aggregate visible.
3. Use sufficient pressure on wood floats to bring moisture to surface.
4. After surface moisture has disappeared, hand steel trowel concrete to produce smooth, smooth dense surface, free from trowel marks.
5. Provide light steel-troweled finish (two trowelings) at air-entrained slabs. Provide hard steel-troweled finish (ringing sound from the trowel) for nonair-entrained slabs.
6. Do not use dry cement or additional water during troweling, nor will excessive troweling be permitted.
7. Power Finishing:
    a. Approved power machine may be used in lieu of or in addition to hand finishing in accordance with directions of machine manufacturer.
    b. Do not use power machine when concrete has not attained necessary set to allow finishing without introducing high and low spots in slab.
    c. Do first steel troweling for slab S-1 finish by hand.

C. Type S-2 (Wood Float Finish):

1. Finish slab to receive fill and mortar setting bed by screeding with straightedges to bring surface to required finish plane.
2. Wood float finish to compact and seal surface.
3. Remove laitance and leave surface clean.
4. Coordinate with other finish procedures.

D. Type S-3 (Underside Elevated Slab Finish). When forming is removed, grind off projections on underside of slab and repair defective areas, including small shallow air pockets where schedule of concrete finishes requires:

1. Prepare surfaces to match Type W-2 (Smooth Wall Finish).

E. Type S-5 (Broomed Finish):

1. Finish as specified for Type S-1 floor finish, except use only a light-steel troweled finish, and then finish surface by drawing fine-hair broom lightly across surface.
2. Broom in same direction and parallel to expansion joints, or, in case of inclined slabs, perpendicular to slope, except for round roof slab, broom surface in radial direction.

F. Type S-6 (Sidewalk Finish):

1. Slope walks down 1/4-inch per foot away from structures, unless otherwise shown.
2. Strike off surface by means of strike board and float with wood or cork float to true plane, then flat steel trowel before brooming.
3. Broom surface at right angles to direction of traffic or as shown.
4. Lay out sidewalk surfaces in blocks, as shown or as directed by Engineer, with grooving tool.

G. Concrete Curbs:

1. Float top surface of curb smooth and finish all discontinuous edges with steel edger.
2. After concrete has taken its initial set, remove front form and give exposed vertical surface an ordinary wall finish, Type W-1.

3.06 CONCRETE SLAB TOLERANCES

A. Slab Tolerances:

1. Exposed Slab Surfaces: Comprise of flat planes as required within tolerances specified.
2. Slab Finish Tolerances and Slope Tolerances: Crowns on floor surface not too high as to prevent 10-foot straightedge from resting on end blocks, nor low spots that allow block of twice the tolerance in thickness to pass under supported 10-foot straightedge.
3. Slab Type S-A: Steel gauge block 5/16-inch thick.
4. Slab Type S-B: Steel gauge block 1/8-inch thick.
5. Slab Type S-A and S-B: Finish Slab Elevation: Slope slabs to floor drain and gutter and shall adequately drain regardless of tolerances.
6. Thickness: Maximum 1/4-inch minus or 1/2-inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2-inch plus.

B. Slab Elevation and Thickness:

1. Finish Slab Elevation: Slope slabs to floor drains and gutter. Slabs shall adequately drain regardless of tolerances.
2. Thickness: Maximum 1/4-inch minus or 1/2-inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2-inch plus.

3.07 BEAM AND COLUMN FINISHES

A. Type B-1: Match wall Type W-1.

B. Type B-2: Match wall Type W-2.

C. Type C-1: Match wall Type W-1.

D. Type C-2: Match wall Type W-2.

3.08 BACKFILL AGAINST STRUCTURES

A. Do not backfill against walls until concrete has obtained specified 28-day compressive strength.

B. Refer to General Structural Notes on the Drawings for additional requirements, including elevated slab and diaphragm completion prior to backfill.

C. Unless otherwise permitted, place backfill simultaneously on both sides of structure, where such fill is required, to prevent differential pressures.

3.09 CLEANING AND STERILIZING OF POTABLE WATER BASINS

A. Clean and sterilize structures for potable water as specified in Section 33 13 00, Disinfection of Water Utility Distribution Facilities.

3.10 FIELD QUALITY CONTROL

A. General:

1. Provide adequate facilities for safe storage and proper curing of concrete test specimens onsite for first 24 hours, and for additional time as may be required before transporting to test lab.
2. Unless otherwise specified, sample concrete for testing for making test specimens, from point of delivery.
3. When concrete is pumped, sample and test air content at point of delivery and at point of placement.
    a. For Each Concrete Mixture: Provided results of air content tests for first load of the day are within specified limits, testing need only be performed at point of delivery for subsequent loads of that concrete mixture except that testing should be performed at point of placement every 4 hours.
4. Evaluation will be in accordance with ACI 301 and Specifications.
5. Test specimens shall be made, cured, and tested in accordance with ASTM C31/C31M and ASTM C39/C39M.

6. Frequency of testing may be changed at discretion of Engineer.
7. Pumped Concrete: Take concrete samples for slump, ASTM C143/C143M, and test specimens, ASTM C31/C31M and ASTM C39/C39M, and shrinkage specimens (ASTM C157/C157M) at placement (discharge) end of line.
8. If measured air content at delivery is greater than specified limit, check test of air content will be performed immediately on a new sample from delivery unit. If check test fails, concrete has failed to meet requirements of Contract Documents. If measured air content is less than lower specified limit, adjustments will be permitted in accordance with ASTM C94/C94M, unless otherwise specified. If check test of adjusted mixture fails, concrete has failed to meet requirements of Contract Documents. Concrete that has failed to meet requirements of Contract Documents shall be rejected.

B. Concrete Strength Test:

1. Unless otherwise specified, one specimen at age of 7 days for information, and two 6-inch diameter or when permitted three 4-inch diameter test specimens at age of 28 days for acceptance.
2. Provide a minimum of one spare test specimen per sample. Test spare cylinder as directed by Engineer.

C. Shrinkage Tests:

1. When required to conform to shrinkage limits, collect actual concrete materials being batched and before liquids have been added to mix.
2. Mix sampled material in a laboratory at proportions matching batched concrete.
3. Test shrinkage characteristics every 5,000 cubic yards of concrete used on job and every 3 months during construction when compression test cylinders are made.
4. Concrete Shrinkage Limits: Test in accordance with ASTM C157/C157M, with the following modifications:
   a. Prisms shall be moist cured for 7 days prior to 28-day drying period.
   b. Comparator reading at end of 7-day moist cure shall be used as initial length in length change calculation.
   c. Reported results shall be average of three prisms.
   d. If drying shrinkage of a specimen departs from average of that test age by more than 0.004 percent, disregard results obtained from that specimen.
   e. Results at end of 28-day drying period shall not exceed 0.040 percent if 3-inch prisms are used or exceed 0.038 percent if 4-inch prisms are used.

D. High-Range, Water-Reducer (Superplasticizer) Admixture Segregation Test: Test each truck prior to use on Project.

1. Segregation Test Objective: Concrete with 4-inch to 8-inch slump shall stay together when slumped. Segregation is assumed to cause mortar to flow out of mix even though aggregate may stay piled enough to meet slump test.
2. Test Procedure: Make slump test and check for excessive slump and observe to see if mortar or moisture flows from slumped concrete.
3. Reject concrete if mortar or moisture separates and flows out of mix.

E. Cold Weather Placement Tests:

1. During cold weather concreting, cast cylinders for field curing as follows. Use method that will produce greater number of specimens:
   a. Six extra test cylinders from last 100 cubic yards of concrete.
   b. Minimum three specimens for each 2 hours of placing time or for each 100 cubic yards.
2. These specimens shall be in addition to those cast for lab testing.
3. Protect test cylinders from weather until they can be placed under same protection provided for concrete of structure that they represent.
4. Keep field test cylinders in same protective environment as parts of structure they represent to determine if specified strength has been obtained.
5. Test cylinders in accordance with applicable sections of ASTM C31/C31M and ASTM C39/C39M.
6. Use test results to determine specified strength gain prior to falsework removal or for prestressing.

F. Tolerances:

1. Walls: Measure and inspect walls for compliance with tolerances specified in Section 03 10 00, Concrete Forming and Accessories.
2. Slab Finish Tolerances and Slope Tolerances:
   a. Make floor flatness measurements day after floor is finished and before shoring is removed to eliminate effects of shrinkage, curing, and deflection.
   b. Support 10-foot long straightedge at each end with steel gauge blocks of thicknesses equal to specified tolerance.
   c. Compliance with designated limits in four of five consecutive measurements is satisfactory, unless defective conditions are observed.

G. Liquid Tightness Tests:

1. Purpose: To determine integrity and liquid-tightness of finished exterior and interior concrete surfaces of liquid containment structures.
2. Test the following structures for liquid-tightness:
   a. Reservoirs.
3. Potable water for initial tightness test will be provided by the Owner through existing facilities. If additional tightness tests are required because of failure to meet criteria, Contractor will pay for water for subsequent tests.
4. After testing has been completed, dispose of test water at a rate and location provided by Owner.
5. Liquid-Tightness Test Requirement:
   a. Perform tightness tests in accordance with ACI 350.1 and as specified herein.
   b. Do not place backfill, coatings, or other work that will cover concrete surfaces until tightness testing has been completed and approved.
   c. Measure evaporation, precipitation, and temperature as specified.
6. Measure water surface at two points 180 degrees apart, when possible, where attachments, such as ladders exist, at 24-hour intervals.
7. Acceptance Criteria:
   a. Volume loss shall not exceed 0.050 percent of contained liquid volume per 24-hour period, adjusted for evaporation, precipitation, and temperature.
   b. Acceptance that structure has passed tightness test shall be based both conformance to the qualitative and quantitative requirements of ACI 350.1.
8. Repairs When Test Fails:
   a. Dewater structure: Fill leaking cracks with crack repair epoxy as specified in Section 03 64 23, Epoxy Resin Injection Grouting.
   b. Patch areas of damp spots previously recorded and repeat water leakage test in its entirety until structure successfully passes test.

3.11 MANUFACTURER'S SERVICES

A. Provide representative at Site in accordance with Section 01 43 33, Manufacturers' Field Services, for installation assistance, inspection, and certification of proper installation for concrete ingredients, mix design, mixing, and placement.

1. Concrete Producer Representative:
   a. Be present during first placement of each type of concrete mix.

b. Assist with concrete mix design, performance, placement, weather problems, and problems as may occur with concrete mix throughout Project, including instructions for redosing.
c. Establish control limits on concrete mix designs.
d. Provide equipment for control of concrete redosing for air entrainment or high-range, water-reducing admixture, superplasticizers, at Site to maintain proper slump and air content if needed.

2. Admixture Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.
3. Bonding Agent Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.

3.12 PROTECTION OF INSTALLED WORK

A. After curing as specified in Section 03 39 00, Concrete Curing, and after applying final floor finish, cover slabs with plywood or particle board or plastic sheeting or other material to keep floor clean and protect it from material and damage as a result of other construction work.

B. Repair areas damaged by construction, using specified repair materials and approved repair methods.

3.13 SCHEDULE OF CONCRETE FINISHES

A. Form Tolerances: As specified in Section 03 10 00, Concrete Forming and Accessories.

B. Provide concrete finishes as scheduled:

Area	Type of Finish	Required Form Tolerances
Exterior Wall Surfaces		
Abovegrade/exposed (above point 6" below finish grade)	W-2	W-B
Backfilled/waterproofed (below point 6" below finish grade)	W-1	W-A
Backfilled/not waterproofed (below point 6" below final grade)	W-1	W-A

Area	Type of Finish	Required Form Tolerances
Interior Wall Surfaces		
Covered water-holding tanks and basins/not painted or coated	W-1	W-A
Water-holding tanks, channels, and basins/painted or coated	W-5	W-A
Buildings, pipe galleries, and other dry areas/not painted or coated	W-2	W-A
Buildings, pipe galleries, and other dry areas/painted or coated	W-5	W-A
Exterior Slabs		
Roof slab/exposed	S-5	S-B
Water-holding tanks and basins/top of wall	S-5	S-B
Top of footing	S-2	S-A
Other water-holding tanks and basins	S-1	S-A
Stairs and landings	S-5	S-B
Sidewalks	S-6	S-B
Other exterior slabs	S-5	S-A
Interior Slabs		
Buildings, pipe galleries, and other dry areas	S-1	S-B
Hydraulic channels	S-1	S-A
Underside of elevated slabs	S-3	S-A
Beams and Columns		
Beams/coated	B-3	B-A
Beams/not coated	B-2	B-A
Columns/coated	C-3	C-A
Columns/not coated	C-2	C-A

3.14 SUPPLEMENTS

A. Requirements of concrete mix designs following “End of Section,” are a part of this Specification and supplement requirements of Part 1 through Part 3 of this section:

1. Concrete Mix Design, Class 5500F3S1P2C2.
2. Concrete Mix Design, Class 4500F2S1P1C1.
3. Concrete Mix Design, Class SM00F2S1P2C1.
4. Concrete Mix Design, Class 3500F1S1P0C1.

END OF SECTION

CONCRETE MIX DESIGN, CLASS 5500F3S1P2C2

A. Mix Locations: Prestressed Concrete Reservoir Core Wall. May be used for any project concrete.

B. Exposure Categories and Classifications: F3S1P2C2.

C. Mix Properties:

1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.40.
2. Minimum concrete compressive strength (f'c) shall be 5,500 psi at 28 days.
3. Designed to conform to shrinkage limits.
4. Air-entraining admixtures are prohibited in concrete mixtures and total air content shall not be greater than 3 percent, for the following:
   a. Slabs to receive hard-troweled finish.
   b. Slabs to receive dry shake floor hardener.
   c. Slabs to receive topping placed monolithically as two-course floor on top of plastic concrete.
5. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in.‡	**Air Content (%)***
3/8	7.5
1/2	7.0
3/4	6.0
1	6.0
1-1/2	5.5
2§	5.0
3§	4.5

Nominal Maximum Aggregate Size in.‡	Air Content (%)*
‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations. *Tolerance of air content is +1-1/2 percent. §Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on the sieved fraction passing the 1-1/2-inch sieve in accordance with ASTM C231/C231M.	

6. Limit supplementary cementitious materials measured as a percent of weight of total cementitious materials in mix design, as follows:
   a. Fly Ash and other Pozzolans: 25 percent.
   b. Slag Cement: 50 percent.
   c. Combined Fly Ash and other Pozzolans and Slag Cement: 50 percent, with fly ash and other pozzolans not exceeding 25 percent.
   d. Total cementitious materials include ASTM C150/C150M and ASTM C595/C595M cement.
      1) Fly ash and other pozzolans in Type IP, blended cement, ASTM C595/C595M.
      2) Slag used in the manufacture of an IS blended cement, ASTM C595/C595M.
7. Provide cementitious materials in accordance with one of the following:
   a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
   b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
      1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
      2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
   c. ASTM C595/C595M Type IL, tested to comply with moderate sulfate resistance option (MS).
      1) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.

8. Unless otherwise permitted, minimum cementitious materials content in mix design shall be as follows:
   a. 515 pounds per cubic yard for concrete with 1-1/2-inch nominal maximum size aggregate.
   b. 535 pounds per cubic yard for 1-inch nominal maximum size aggregate.
   c. 560 pounds per cubic yard for 3/4-inch nominal maximum size aggregate.
   d. 580 pounds per cubic yard for 1/2-inch nominal maximum size aggregate.
   e. 600 pounds per cubic yard for 3/8-inch nominal maximum size aggregate.
   f. Unless otherwise permitted, limit cementitious materials content to 100 pounds per cubic yard greater than specified minimum cementitious materials content in mix design.
9. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent, unless otherwise specified.
   a. Regardless of assigned C Exposure Class, for prestressed and post-tensioned concrete: 0.06 percent.
   b. Limits are stated in terms of chloride ions in percent by weight of cement.
   c. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.

D. Refer to Part 1 through Part 3 of this section for additional requirements.

CONCRETE MIX DESIGN, CLASS 4500F2S1P1C1

A. Mix Locations: Typical Concrete.

B. Exposure Categories and Classifications: F2S1P1C1.

C. Mix Properties:

1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.45.
2. Minimum concrete compressive strength (f'c) shall be 4,500 psi at 28 days.
   a. Designed to conform to shrinkage limits.
   b. Air-entraining admixtures are prohibited in concrete mixtures and total air content shall not be greater than 3 percent, for the following:
      1) Slabs to receive a hard-troweled finish.
      2) Slabs to receive a dry shake floor hardener.
      3) Slabs to receive a topping placed monolithically as a two-course floor on top of plastic concrete.
   c. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in. ‡	**Air Content (%)***
3/8	7.5
1/2	7.0
3/4	6.0
1	6.0
1-1/2	5.5
2§	5.0
3§	4.5

Nominal Maximum Aggregate Size in. ‡	Air Content (%)*
‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations. *Tolerance of air content is +1-1/2 percent. §Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on sieved fraction passing 1-1/2-inch sieve in accordance with ASTM C231/C231M.	

3. Provide cementitious materials in accordance with one of the following:
   a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
   b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
      1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
      2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
      3) ASTM C595/C595M Type IL, tested to comply with moderate sulfate resistance option (MS).
4. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent, unless otherwise specified.
   a. Limits are stated in terms of chloride ions in percent by weight of cement.
   b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.

D. Refer to Part 1 through Part 3 of this section for additional requirements.

CONCRETE MIX DESIGN, CLASS SM00F2S1P2C1

A. Mix Locations: Slurry mixture at horizontal construction joints with waterstop in wall.

B. Exposure Categories and Classifications: F2S1P2C1.

C. Mix Properties:

1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.42.
2. Minimum concrete compressive strength (f'c) shall be same as concrete mix for wall.
3. Maximum Nominal Aggregate: 3/8 inch.
4. Unless otherwise specified, provide 7.5 percent air content.
    a. See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations.
    b. Tolerance of air content is plus or minus 1.5 percent.
5. Provide cementitious materials in accordance with one of the following:
    a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
    b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
        1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
        2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
    c. ASTM C595/C595M Type IL tested to comply with moderate sulfate resistance option (MS).
        1) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
6. Unless otherwise permitted, minimum cementitious materials content in mix design shall be 600 pounds per cubic yard for 3/8-inch nominal maximum size aggregate.

7. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent, unless otherwise specified.
   a. Regardless of Assigned C Exposure Class, for Prestressed and Post-tensioned Concrete: 0.06 percent.
   b. Limits are stated in terms of chloride ions in percent by weight of cement.
   c. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.

D. Refer to Part 1 through Part 3 of this section for additional requirements.

CONCRETE MIX DESIGN, CLASS 3500F1S1P0C1

A. Mix Locations:

1. Electrical duct banks.
2. Pipe encasements that are not cast monolithically with concrete base mats or slabs.
3. Where specified in Contract Documents.

B. Exposure Categories and Classifications: F1S1P0C1.

C. Mix Properties:

1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.45.
2. Minimum concrete compressive strength (f'c) shall be 3,500 psi at 28 days.
3. Air-entraining admixtures are prohibited in concrete mixtures and total air content shall not be greater than 3 percent, for the following:
   a. Slabs to receive hard-troweled finish.
   b. Slabs to receive dry shake floor hardener.
   c. Slabs to receive topping placed monolithically as two-course floor on top of plastic concrete.
4. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in. ‡	**Air Content (%)***
3/8	6.0
1/2	5.5
3/4	5.0
1	4.5
1-1/2	4.5
2§	4.0
3§	3.5

Nominal Maximum Aggregate Size in. ‡	Air Content (%)*
‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations. *Tolerance of air content is +1-1/2 percent. §Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on the sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on the sieved fraction passing the 1-1/2-inch sieve in accordance with ASTM C231/C231M.	

5. Provide cementitious materials in accordance with one of the following:
   a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
   b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
      1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
      2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
      3) ASTM C595/C595M Type IL tested to comply with moderate sulfate resistance option (MS).
         a) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent, unless otherwise specified.
   a. Limits are stated in terms of chloride ions in percent by weight of cement.
   b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.

D. Refer to Part 1 through Part 3 of this section for additional requirements.

SECTION 03 39 00
CONCRETE CURING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI): 308.1, Specification for Curing Concrete.
2. ASTM International (ASTM):
   a. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   b. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
3. NSF International: 61, Drinking Water System Components – Health Effects.

1.02 SUBMITTALS

A. Action Submittals:

1. Manufacturers' data indicating compliance with the requirements specified herein for the following products:
   a. Evaporation retardant.
   b. Curing compound.
2. Curing methods proposed for each type of element such as slab, walls, beams, and columns in each facility.

B. Informational Submittals:

1. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for the following:
   a. Curing compound showing moisture retention requirements.

PART 2 PRODUCTS

2.01 MATERIALS

A. Curing Compound:

1. Water-based, high-solids content, nonyellowing, curing compound meeting requirements of ASTM C1315 Type I, Class A.

2. Manufacturers and Products:
    a. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.
    b. WR Meadows, Inc., Hampshire, IL; VOCOMP-30.
    c. Vexcon Chemical, Inc.; Philadelphia, PA; Starseal 1315.
    d. Dayton Superior; Safe Cure and Seal 1315 EF.

B. Evaporation Retardant:

1. Optional: Fluorescent fugitive dye color tint that disappears completely upon drying.
2. Manufacturers and Products:
    a. BASF Construction Chemicals, Shakopee, MN; MasterKure ER 50.
    b. Euclid Chemical Co., Cleveland, OH; Eucobar.

C. Water: Clean and potable, containing less than 500 ppm of chlorides.

PART 3 EXECUTION

3.01 CONCRETE CURING

A. General:

1. Cure all concrete in accordance with project specifications and ACI308.1.
2. Where surfaces are to receive coatings, painting, cementitious material, or other similar finishes, use only water curing procedures. Refer to Interior Finish Schedule for surfaces to receive coatings.
3. Use only water curing on potable water structures.
4. Where curing compound cannot be used, water curing as described below or special methods using moisture shall be agreed upon by Engineer prior to placing concrete.
5. As required in Section 03 30 00, Cast-in-Place Concrete, if result of 7-day concrete strength test is less than 50 percent of specified 28-day strength, extend period of moist curing specified below, by 7 additional days.

B. Use one of the following methods as approved by Engineer:

1. Vertical Surfaces
    a. Method 1: Leave concrete forms in place and keep surfaces of forms and concrete wet for 14 days.
    b. Method 2: Continuously sprinkle with water 100 percent of exposed surfaces for 14 days starting immediately after removal of forms.

c. Method 3: Apply curing compound, where allowed, immediately after removal of forms.

2. Horizontal Surfaces:
   a. Method 1: Protect surface by water ponding for 14 days.
   b. Method 2: Cover with burlap or cotton mats and keep continuously wet for 14 days.
   c. Method 3: Cover with 1-inch layer of wet sand, earth, or sawdust, and keep continuously wet for 14 days.
   d. Method 4: Continuously sprinkle exposed surface for 14 days.
   e. Method 5: Apply curing compound, where allowed, immediately after final finishing when surface will no longer be damaged by traffic.

3.02 EVAPORATION RETARDANT APPLICATION

A. Use on flatwork when environmental conditions are anticipated to cause rapid drying of the concrete surface. Do not use evaporation retardant on potable water structures, unless product is NSF 61 approved.

B. Spray onto surface of fresh flatwork concrete immediately after screeding to react with surface moisture.

C. Reapply as needed to ensure a continuous moist surface until final finishing is completed.

3.03 PRESTRESSED TANK CONCRETE CURING

A. Keep concrete surfaces and form continuously wet for 14 days where Portland cement is used, or 7 days where high-early-strength cement is used.

B. Begin curing immediately after initial concrete set has occurred.

C. Do not use curing compounds.

3.04 MANUFACTURER’S SERVICES

A. Provide manufacturer’s representative at Site for installation assistance, inspection, and certification of proper installation for products specified.

B. Provide curing compound manufacturer’s representative to demonstrate proper application of curing compound to show coverage in one coat.

END OF SECTION

SECTION 03 63 00
CONCRETE DOWELING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American National Standards Institute (ANSI).
2. ASTM International (ASTM):
   a. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
   b. E488, Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
3. International Code Council (ICC):
   a. 2021 International Building Code (IBC).
   b. Evaluation Services Reports.
4. NSF International (NSF): 61, Drinking Water System Components-Health Effects.

1.02 DEFINITIONS

A. ICC Evaluation Services Report: Published by ICC for products provided by concrete adhesive anchor manufacturers.

B. Special Inspection: As defined in the ICC IBC and indicated on the Statement of Special Inspection (Plan) in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing.

1.03 SUBMITTALS

A. Action Submittals:

1. Product Data: Manufacturer’s catalog information.

B. Informational Submittals:

1. Manufacturer’s instructions for preparation, placement, drilling of holes, installation of anchors and adhesive, and handling of cartridges, nozzles, and equipment.
2. ICC Evaluation Services Report: Specific to proposed doweling system manufacturer.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Adhesive shall be certified as meeting NSF 61 for use in potable water structures.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Container Markings: Include manufacturer's name, product name, batch number, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

B. Store adhesive components in accordance with manufacturer's written instructions.

C. Dispose of when:

1. Shelf life has expired.
2. Stored other than per manufacturer's instructions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Adhesive:

1. Approved by an ICC Evaluation Services Report for conformance to 2021 IBC requirements for doweling of steel reinforcing bars in cracked concrete.
2. Suitable for long-term loads as well as for wind and seismic loads.
3. Meet requirements of ASTM C881/C881M.
4. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
5. Disposable, Self-Contained Cartridge System:
   a. Capable of dispensing both components in proper mixing ratio.
   b. Fit into manually or pneumatically operated caulking gun.
6. Mixed Adhesive: Nonsag, light paste consistency with ability to remain in a 1-inch diameter overhead drilled hole without runout.
7. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
8. Potable Water Structures: Adhesive shall be acceptable for use by NSF 61.
9. Manufacturers and Products:
   a. Hilti, Inc., Tulsa, OK; HIT-RE 500-V3 (ESR-3814) or HIT-HY 200 (ESR-3187) Adhesive Anchors.
   b. Powers Fasteners, Brewster, NY; Power PURE110+ Epoxy Adhesive Anchor System (ESR-3298).

c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-XP Epoxy Adhesive Anchors (ESR-2508).

B. Mixing Nozzles: Disposable, manufactured in several sizes to accommodate size of reinforcing dowels.

C. Reinforcing Dowels: As specified in Section 03 21 00, Steel Reinforcement.

PART 3 EXECUTION

3.01 INSTALLATION

A. Drilling Equipment:

1. Drilling Hammers for Dowel Holes:
   a. Electric or pneumatic rotary type with medium or light impact.
   b. Hollow drills with flushing air systems are preferred.
2. Where edge distances are less than 2 inches, use lighter impact equipment to prevent microcracking and concrete spalling during drilling process.

B. Hole Diameter: Use drill bit diameter meeting ICC Evaluation Services Report requirements and as recommended by manufacturer.

C. Obstructions in Drill Path: When existing steel reinforcement is encountered during drilling, obtain Engineer approval for proposed fix.

D. Doweling:

1. Install per details shown on Drawings and in accordance with adhesive manufacturer’s instructions.
2. When using epoxy anchors, dowels may be prebent prior to installation to 15 degrees to align with other bars. Do not heat dowels to bend.
3. Bent Bar Dowels: Where edge distances are critical, and intersection with steel reinforcement is likely, drill hole at 10-degree angle or less and use prebent reinforcing bars.

E. Adhesive:

1. Install in accordance with written manufacturer’s instructions.
2. Dispense components through specially designed static mixing nozzle that thoroughly mixes components and places mixed adhesive at base of predrilled hole.

3.02 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in the Statement of Special Inspection (Plan) in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information on special inspection and testing are included in Section 01 45 33, Special Inspection, Observation, and Testing.

1. Special inspection will be performed by the Special Inspector in accordance with ICC ESR requirements and as specified in Section 01 45 33, Special Inspection, Observation, and Testing.
2. Continuous inspection required where noted in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing and where concrete dowels are installed in overhead applications.
3. Periodic inspection required where continuous inspection is not specified.
4. Special Inspector will observe installation in accordance with requirements of the ICC Evaluation Services Report and will submit report including the following:
    a. Product Description: Product name, rod diameter, and length.
    b. Drill bit compliance.
    c. Hole diameter, diameter, and depth and cleanliness.
    d. Adhesive expiration date.
5. Verification of dowel installation in accordance with manufacturer’s published instructions

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 03 64 23
EPOXY RESIN INJECTION GROUTING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C882, Standard Specification for Test Method for Bond Strength of Epoxy Resin System Used with Concrete by Slant Shear.
   b. D570, Standard Test Method for Water Absorption of Plastics.
   c. D638, Standard Test Method for Tensile Properties of Plastics.
   d. D648, Standard Test Method for Deflection Temperature of Plastics under Flexural Load in the Edgewise Position.
   e. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
   f. D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
2. National Sanitation Foundation (NSF):
   a. Standard 60, Standard for Drinking Water Treatment and Chemicals-Health Effects.
   b. Standard 61, Standard for Drinking Water System Components-Health Effects.

1.02 DEFINITIONS

A. Crack: Complete or incomplete separation of concrete into two or more parts produced by breaking or fracturing.

B. Defective Area: As defined in Section 03 30 00, Cast-in-Place Concrete.

C. Hydraulic Structure: Liquid containment structure and/or structure designed to mitigate liquid infiltration.

D. Injection: Method of bonding together, addressing or eliminating leakage through cracks or joints by installing resin under pressure to fill the void in crack or joint.

E. Joint: A planned and formed discontinuity in concrete structure at junction of adjacent and sequential concrete placements and may contain embedded waterstops.

F. Leak or Leakage: Crack or joint exhibiting presence of moisture, sign of efflorescence, intermittently wet to touch, or continuous flow of liquid.

G. Narrow Cracks: Width equal to or less than 0.015 inch.

H. Wide Cracks: Wider than 0.015 inch.

1.03 SUBMITTALS

A. Action Submittals:

1. Physical and chemical properties for epoxy resin.
2. Technical data for metering, mixing, and injection equipment.
3. Depth of penetration, length, material used, and procedures where epoxy is approved for use.
4. Marked up drawings of proposed epoxy injection repair crack locations, widths, and lengths and direction on structure.
5. Sample bottle.

B. Informational Submittals:

1. Manufacturer’s recommended surface preparation procedures and application instructions for epoxy resins.
2. Manufacturer’s Certificate of Compliance in accordance with Section 01 61 00, Common Product Requirements. Certified test results for each batch of epoxy resin.
3. Certificate for NSF 61 conformance.
4. Statements of Qualification for Epoxy Resin:
   a. Manufacturer’s Site representative.
   b. Injection applicator.
   c. Injection pump operating technician.
5. Sample of epoxy resin two component ratio and injection pressure test records for concrete crack repair work.
6. Installation instructions for repairing core holes with repair mortar.
7. Health and Safety Plans for acid flushing work. Test results of epoxy resin bond tests.
8. Epoxy resin two component ratio and injection pressure test records for concrete crack repair work.

1.04 QUALITY ASSURANCE

A. Qualifications for Injection Staffs:

1. Manufacturer’s Site Representative:
   a. Capable of instructing successful methods of epoxy injection process for concrete structure.

b. Understands and is capable of explaining technical aspects of correct material selection and use.
c. Experienced in operation, maintenance, and troubleshooting of application equipment.

2. Injection Crew and Job Foreman:
   a. Provide written and verifiable evidence showing compliance with the following requirements:
      1) Licensed or certified by epoxy resin material manufacturer.
      2) Minimum 3 years' experience in successful epoxy injection for at least 10,000 linear feet of successful crack injection, including 2,000 linear feet of wet crack injection to stop water leakage.

B. Injected Epoxy Resin: Fill cracks and joints with minimum resin depth penetration no less than 90 percent of:

1. Full thickness of concrete section for cracks or joints.
2. Depth between waterstop and inside face of structure for joints with an embedded waterstop.

C. Injected cracks and joints which leak shall be considered deficient work irrespective of depth of penetration. Reinjection of deficient work or, with approval of Engineer, provide other repairs to eliminate leakage.

D. Bond Strength Test for Epoxy Resin:

1. Concrete failure before resin failure.
2. 1,500 psi minimum bond strength per ASTM C882 test requirements with no failure of either concrete or epoxy resin.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping:

1. Package resin material in new sealed containers and label with following information:
   a. Manufacturer's name.
   b. Product name and lot number.

B. Storage and Protection: Store epoxy resin material containers in accordance with manufacturer's printed instructions and at ambient temperatures below 110 degrees F and above 45 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials and accessories specified in this section shall be products of:

1. BASF Construction Chemicals, LLC-Building Systems, Shakopee, MN; SCB Concresive Series products that meet properties indicated in sub-section 2.2.B.
2. Sika Corp., Lyndhurst, NJ; Sikadur Series products that meet properties below.
3. Euclid Chemical Co., Cleveland, OH; Euco Series (#452) products that meet properties below.

2.02 EPOXY INJECTION RESIN

A. Two-component A and B structural epoxy resin for injection into cracks or joints or other voids in concrete structures for bonding or grouting.

B. Uncured Resin Properties:

1. When mixed in ratio specified on resin container label:

	Test Method	**Wide Cracks or Joints**	**Narrow Cracks or Joints**
Pot Life (60-gram mass) @ 77, plus or minus 4 deg F	As specified in Article Source Quality Control	13 to 25 minutes	15 to 30 minutes
Pot Life (60-gram mass) @ 100, plus or minus 4 deg F	As specified in Article Source Quality Control	3 to 10 minutes	10 to 20 minutes
Viscosity @ 40, plus or minus 3 deg F	Brookfield RVT Spindle No. 4 @ 20 rpm	4,400 cps	600 cps
Viscosity @ 75 to 77 deg F	Brookfield RVT Spindle No. 2 @ 20 rpm	375 to 350 cps	175 to 140 cps

C. Epoxy Resin Properties: When cured for 7 days at 77 degree F, plus or minus 3 degrees F and conditioned at test temperature 12 hours prior to test, unless otherwise specified.

	Test Method	Wide Cracks or Joints	Narrow Cracks or Joints
Ultimate Tensile Strength, psi	ASTM D368	8,000 min.	5,000 min.
Tensile Elongation @ Break, percent	ASTM D638	4.2 max.	3.0 max.
Flexural Strength, psi	ASTM D790	10,000 min.	10,000 min.
Flexural Modulus, psi	ASTM D790	5.5×10^5 min.	4.5×10^5 min.
Compressive Yield Strength, psi	ASTM D695*	15,000 min.	12,000 min.
Compressive Modulus, psi	ASTM D695*	4.0×10^5 min.	4.0×10^5 min.
Heat Deflection Temperature	ASTM D648*	130 deg F min.	140 deg F min.
Cured 3 days @ 40 deg F – Wet Concrete		3,500 psi min.	3,500 psi min.
Cured 1 day @ 77 deg F – Dry Concrete		5,000 psi min.	5,000 psi min.
Cured 3 days @ 77 deg plus or minus 3 deg F		5,000 psi min.	5,000 psi min.

*Cure test specimens so that peak exothermic temperature of resin does not exceed 100 degrees F.

Note: See referenced specifications for preparation method of test specimens.

2.03 SURFACE SEAL

A. Sufficient strength and adhesion for holding injection fittings firmly in place and to resist pressures preventing leakage during injection.

B. Capable of removal after injection resin has cured.

2.04 WATER

A. Clean and free from oil, acid, alkali, organic matter, or other deleterious substances, meeting federal drinking water standards.

2.05 SAMPLE BOTTLE

A. Five-inch natural wide mouth HDPE bottle or 4-ounce clear PVC cylinder bottle; supplied with caps.

2.06 SOURCE QUALITY CONTROL

A. Test Requirements: Perform tests for each batch of epoxy resin.

B. Pot Life Test:

1. Condition Component A and Component B to required temperature.
2. Measure components in ratio of Component B as stated on manufacturer's label into an 8-fluid ounce paper cup.
3. Mix components for 60 seconds using non-metallic stirring instrument. Scrape sides and bottom of cup periodically.
4. Probe mixture once with non-metallic stirring instrument every 30 seconds, starting 2 minutes prior to minimum specified pot life.
5. Pot Life Definition: Time at which a soft stringy mass forms in center of cup.

C. Slant Shear Test: Prepare specimens and perform tests in accordance with ASTM C882.

PART 3 EXECUTION

3.01 GENERAL

A. Unless permitted otherwise, structurally repair cracks or joints listed below:

1. Cracks considered to be defective as defined in Section 03 30 00, Cast-in-Place Concrete.

B. Do not proceed with injection work until submittals have been reviewed and approved by Engineer.

C. Perform cracks or joints injection work after removing defective surface materials and after performing surface preparation, but prior to applying surface repair material unless otherwise noted.

D. Width of cracks may vary along length and through thickness of concrete section.

E. Remove all excess, unused epoxy resin materials on concrete surfaces exposed to view prior to end of Work.

3.02 EQUIPMENT

A. Portable, positive displacement type pumps with in-line metering to meter and mix two epoxy resin components and inject mixture into cracks or joints.

B. Pumps:

1. Electric or air powered with interlocks providing positive ratio control of proportions for the two components at nozzle.
2. Primary injection pumps for each material of different mix ratio, including a standby backup pump of similar ratio.
3. Capable of immediate compensation for changes in resins.
4. Do not use batch mix pumps.

C. Discharge Pressure: Automatic pressure controls capable of discharging mixed epoxy resin at pressures in accordance with epoxy resin manufacturer's printed instruction and able to maintain pressure.

D. Automatic Shutoff Control: Provide sensors on both Component A and Component B reservoirs for stopping machine automatically when only one component is being pumped to mixing head.

E. Proportioning Ratio Tolerance: Maintain epoxy resin manufacturer's prescribed mix ratio within a tolerance of plus or minus 5 percent by volume at discharge pressure up to 160 psi.

F. Ratio/Pressure Check Device:

1. Two independent valve nozzles capable of controlling flow rate and pressure by opening or closing valve to restrict material flow.
2. Pressure gauge capable of sensing pressure behind each valve.

3.03 PREPARATION

A. Free cracks or joints from loose matter, dirt, laitance, oil, grease, efflorescence, salt, and other contaminants.

B. Clean cracks or joints in accordance with epoxy resin manufacturer's instructions.

C. Clean surfaces adjacent to cracks or joints from dirt, dust, grease, oil, efflorescence, and other foreign matter detrimental to bond of surface seal system and to expose the full extent of cracks and joints in accordance with manufacturer's printed instruction.

D. Do not use acids and corrosives for cleaning, other than those specified herein unless neutralized prior to injecting epoxy resin.

E. During installation and curing of materials, if ambient temperature is expected to drop below manufacturer's recommended minimum temperature, provide enclosures and heat as required.

F. Provide work platforms as required.

G. Dry out cracks or joints if required by manufacturer’s instructions.

3.04 APPLICATION

A. All liquid is to be removed from hydraulic structure prior to commencing with epoxy injection, unless approved otherwise.

B. Entry Ports:

1. Establish openings for epoxy resin entry in surface seal along crack.
2. Determine space between entry ports equal to thickness of concrete member to allow epoxy resin to penetrate to the full thickness of the member.
3. Drill injection holes at an angle between 45 degrees and 60 degrees from surface of concrete and perpendicular to alignment of cracks or joints, to intersect crack or joint at midpoint of concrete section, and intersect joints at midpoint between waterstop and interior concrete surface, except as noted otherwise.
4. Locate drill holes on alternate sides of crack or joint where possible, unless orientation of crack or joint is known or has been verified by non-destructive testing techniques or core drilling.
5. Drill Hole Spacing: Do not to exceed concrete thicknesses or 12 inches maximum, except as noted otherwise.
6. Adjust location and angle of drill holes to suit orientation of crack or joint and at commencement of drilling holes for injection.
7. Take measures to prevent drilling holes for injection too shallow or too deep, or damaging existing waterstop in joints.
8. Remove dust and debris in drill holes and on surface of structure resulting from drilling operation, by flushing with water prior to installing the injection packers or ports.
9. Space entry ports closer together to allow adjustment of injection pressure to obtain minimum loss of epoxy to soil at locations where:
    a. Cracks or joints extend entirely through concrete element.
    b. Backfill of walls on one side.
    c. Slab-on-grade.
    d. Difficult to excavate behind wall to seal both surfaces of crack.
10. Install injection packers or ports in drill holes in accordance with manufacturer’s printed instructions with zerk coupling or other one-way ball or check valve, to permit testing for watertightness and acid flushing of cracks and joints.

C. Application of Surface Seal along Cracks and Joints:

1. Apply surface seal in accordance with manufacturer's instructions to designated cracks and joints face prior to injection. Seal surface of cracks or joints to contain and prevent escape of injection epoxy.
2. Cure surface seal in accordance with manufacturer's printed instructions before commencing inject work.

D. Epoxy Injection:

1. Ensure zerk coupling is not installed in ports or packers next to the one being injected.
2. Start injection into each crack or joint at lowest elevation entry port or packer along vertical or diagonal crack or joint, and at one end of horizontal crack or joint.
3. Where injection entry ports or packers are used, continue injection at first port or packer until resin begins to flow out of port or packer at next highest elevation. Plug first port or packer and start injection at second port or packer until resin flows from next port or packer.
4. Inject entire crack or joint with same sequence.
5. At no time inject more than 6 feet length of first vertical crack or joint before verifying resin in sample bottle has start to set and cure.
6. Prior to commencing injection work along a horizontal crack or joint in structure when processed using ports or packers with zerk couplings are used, remove zerk couplings from injection ports or packers except for two ports or packers located where injection work will commence. Commence injection work in first two ports or packers. Once clean resin is vented from third injection port or packer, cease injection at first port or packer, and install zerk coupling and commence injection at third port or packer. Repeat process for fourth and subsequent ports or packers until full length of crack or joint has been injected.

E. Finishing:

1. Allow epoxy resin to cure in accordance with manufacturer's instruction after cracks or joints have been completely injected to allow surface seal removal without draining or runback of uncured epoxy resin material from cracks or joints.
2. Remove surface seal and injection packers or ports from cured injection resin along crack.
3. Finish crack or joint faces flush with adjacent concrete.
4. Indentations or protrusions caused by placement of entry ports, packers, drill holes, or damage from removal of surface seal is not acceptable.

5. Grind off protrusions and patch indentations and holes from injection packers and entry ports with a suitable patch material to satisfaction of Engineer.
6. Remove surplus surface seal material splatters and injection resin material runs and spills from concrete surfaces.

3.05 FIELD QUALITY CONTROL

A. Epoxy Resin Two Component Ratio Tests:

1. Disconnect mixing head and pump two resin components simultaneously through ratio check device.
2. Adjust discharge pressure to 160 psi for both resin components.
3. Simultaneously discharge both resin components into separate calibrated containers.
4. Compare amounts simultaneously discharged into calibrated containers during same time period to determine mix ratio.
5. Complete test at 160 psi discharge pressure and repeat procedure for 0 psi discharge pressure.
6. Run ratio test for each injection unit at beginning and end of each injection work day, and when injection work has stopped for more than 1 hour.
7. Document and maintain complete accurate records of ratios and pressure checks.

B. Injection Pressure Test:

1. Disconnect mixing head of injection equipment and connect two resin component delivery lines to pressure check device.
2. Pressure Check Device:
   a. Two independent valved nozzles capable of controlling flow rate and pressure by opening or closing of valve.
   b. Pressure gauge capable of sensing pressure buildup behind each valve.
3. Close valves on pressure check device and operate equipment until gauge pressure on each line reads 160 psi.
4. Stop pumps and observe pressure; do not allow pressure gauge to drop below 150 psi within 3 minutes.
5. Run pressure test for each injection equipment unit:
   a. Beginning and end of each injection work day.
   b. When injection work stop for more than 45 minutes.
6. Check tolerance to verify equipment capable of meeting specified ratio tolerance.

C. Bottled Sample Tests:

1. During injection operation, provide at least one sample of mixed epoxy resin for each injection pump per shift per injection work day in a sample bottle.
2. Provide sufficient sample to demonstrate sample material epoxy resin will set and cure correctly.
3. Label each bottled sample with Contractor's name, date, and time sample was taken, and location in structure where sample was taken. Record details of bottle sample tests.
4. Place filled sample bottle upright in a container and allow sample to cure.
5. After sample has been allowed to cure, cut bottled sample open and visually inspect contents to verify that epoxy resin material has completely reacted and cured.
6. Evaluation and Assessment of Test:
    a. Should bottled sample(s) indicate a problem; such as epoxy resin not cured or foreign liquid in sample bottle, take verifying core sample immediately from cracks or joints, where material was used.
    b. Should above-referenced bottle sample(s) and core sample(s) indicate a problem with epoxy resin, arrange to have a Technical Representative of the epoxy resin manufacturer come to Site to review bottled sample(s) and core drilled sample(s) with Engineer and provide technical advice on corrective measures.
    c. Carry out further investigation work or corrective measures recommended by Technical Representative of epoxy resin manufacturer.

END OF SECTION

SECTION 05 05 19
POST-INSTALLED ANCHORS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 318, Building Code Requirements for Structural Concrete.
   b. 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
   c. 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete.
2. American Iron and Steel Institute (AISI): Stainless Steel Type 316.
3. American National Standards Institute (ANSI).
4. ASTM International (ASTM):
   a. A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   b. A143, Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
   c. A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   d. A193/A193M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
   e. A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
   f. A380, Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
   g. A385, Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
   h. A563, Specification for Carbon and Alloy Steel Nuts.
   i. A780, Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
   j. A967, Specification for Chemical Passivation Treatments for Stainless Steel Parts.
   k. E488, Standard Test Methods for Strength of Anchors in Concrete Elements.
   l. F436, Specification for Hardened Steel Washers.
   m. F468, Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.

n. F568M, Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners.
o. F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
p. F594, Specification for Stainless Steel Nuts.
q. F1554, Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

5. International Association of Plumbing and Mechanical Officials Uniform ES (IAPMO-UES): Evaluation Reports for Concrete and Masonry Anchors.
6. International Code Council Evaluation Service (ICC-ES):
   a. Evaluation Reports for Concrete and Masonry Anchors.
   b. AC01, Acceptance Criteria for Expansion Anchors in Masonry Elements.
   c. AC70, Acceptance Criteria for Fasteners Power-driven into Concrete, Steel and Masonry Elements.
   d. AC106, Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements.
   e. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
   f. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements. Evaluation Reports for Concrete and Masonry Anchors.
7. NSF International (NSF): 61, Drinking Water System Components-Health Effects.
8. Specialty Steel Industry of North America (SSINA):
   a. Specifications for Stainless Steel.
   b. Design Guidelines for the Selection and Use of Stainless Steel.
   c. Stainless Steel Fabrication.
   d. Stainless Steel Fasteners.

1.02 DEFINITIONS

A. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.

B. Exterior Area: Location not protected from weather by a building or other enclosed structure to include buried roof structures.

C. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or wash down, and where wall or roof slab is not common to a water-holding or earth-retaining structure.

D. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or wash down, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.

E. Submerged: Location at or below top of wall of open water-holding structure, such as a basin or channel, or wall, ceiling, or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Specific instructions for concrete anchor installation, including drilled hole size and depth, preparation, placement, procedures, and instructions for safe handling of anchoring systems.

B. Informational Submittals:

1. Concrete Anchors:
   a. Manufacturer’s product description and installation instructions.
   b. Current ICC-ES or IAPMO-UES Report for each type of post-installed anchor to be used.
2. Passivation method for stainless steel members.

1.04 QUALITY ASSURANCE

A. Qualifications: Installers of adhesive anchors horizontally or upwardly inclined to support sustained tension loads shall be certified by an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Installer Certification Program or equivalent.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package stainless steel items in a manner to provide protection from carbon impregnation.

PART 2 PRODUCTS

2.01 GENERAL

A. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Stainless Steel:	
Threaded Rods	F593, AISI Type 316, Condition CW
Nuts*	F594, AISI Type 316, Condition CW
*Nuts of other grades and styles having specified proof load stresses greater than specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than minimum tensile strength of specified threaded rod.	

B. Bolts, Washers, and Nuts: Use stainless steel.

2.02 POST-INSTALLED CONCRETE ANCHORS

A. General:

1. AISI Type 316 stainless.
2. Post-installed anchor systems used in concrete shall be approved by ICC Evaluation Services Report or equivalent for use in cracked concrete and for short-term and long-term loads including wind and earthquake.
3. Mechanical Anchors: Comply with the requirements of ICC-ES AC193 or ACI 355.2.
4. Adhesive Anchors: Comply with the requirements of ICC-ES AC308 or ACI 355.4.
5. Acceptable for use in potable water structures by EPA and local health agencies or NSF 61.

B. Torque-Controlled Expansion Anchors (Wedge Anchors):

1. Manufacturers and Products:
   a. Hilti, Inc., Tulsa, OK; Kwik-Bolt –TZ (KB-TZ) Anchors (ESR-1917).
   b. DeWalt/Powers Fasteners, Brewster, NY; Power-Stud +SD1, +SD2, +SD4, or +SD6 Anchors (ESR-2502 and ESR-2818).
   c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 Anchors (ESR-1771 and ESR-3037).

C. Adhesive Anchors:

1. Threaded Rod:
   a. Diameter as shown on Drawings.
   b. Length as required to provide minimum depth of embedment indicated and thread projection required.
   c. Clean and free of grease, oil, or other deleterious material.
2. Adhesive:
   a. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
   b. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
3. Packaging and Storage:
   a. Disposable, self-contained system capable of dispensing both components in proper mixing ratio and fitting into a manually or pneumatically operated caulking gun.
   b. Store adhesive on pallets or shelving in a covered storage area.
   c. Package Markings: Include manufacturer's name, product name, batch number, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
   d. Dispose of When:
      1) Shelf life has expired.
      2) Stored other than in accordance with manufacturer's instructions.
4. Manufacturers and Products:
   a. Hilti, Inc., Tulsa, OK; HIT Doweling Anchor System, HIT RE 500 V3 (ESR-3814), or HIT-HY 200 (ESR-3187).
   b. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-XP Epoxy Adhesive Anchors (ESR-2508), or AT-XP Adhesive Anchors (IAPMO UES-263).
   c. DeWalt/Powers Fasteners, Brewster NY; Pure 220+ Epoxy adhesive anchor system (ESR-5144).

D. Adhesive Threaded Inserts:

1. Type 316 stainless steel, internally threaded inserts.
2. Manufacturer and Product: Hilti, Inc., Tulsa, OK; HIS-RN Insert with HIT-RE 500-V3 or HIT-HY 200 adhesive.

PART 3 EXECUTION

3.01 CONCRETE ANCHORS

A. Begin installation only after concrete to receive anchors has attained design strength.

B. Locate existing reinforcing with Ground Penetrating Radar or other method approved by Engineer prior to drilling. Coordinate with Engineer to adjust anchor locations where installation would result in hitting reinforcing.

C. Install in accordance with written manufacturer's instructions.

D. Provide minimum embedment, edge distance, and spacing as indicated on Drawings.

E. Use only drill type and bit type and diameter recommended by anchor manufacturer.

F. Clean hole of debris and dust per manufacturer's requirements.

G. When unidentified embedded steel, rebar, or other obstruction is encountered in drill path, slant drill to clear obstruction. If drill must be slanted more than indicated in manufacturer's installation instructions to clear obstruction, notify Engineer for direction on how to proceed.

H. Adhesive Anchors:

1. Unless otherwise approved by Engineer and adhesive manufacturer:
   a. Do not install adhesive anchors when temperature of concrete is below 40 degrees F or above 100 degrees F.
   b. Do not install prior to concrete attaining an age of 21 days.
   c. Remove any standing water from hole with oil-free compressed air. Inside surface of hole shall be dry.
   d. Do not disturb anchor during recommended curing time.
   e. Do not exceed maximum torque as specified in manufacturer's instructions.

I. Prestressed Concrete: Do not use drilled-in anchors in prestressed or post-tensioned concrete members without Engineer's prior approval unless specifically shown on Drawings.

3.02 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

3.03 FASTENER SCHEDULE

A. Unless indicated otherwise on Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks
1. Post-Installed Anchors for Metal Components to Cast-in-Place Concrete (such as, Ladders, Handrail Posts, Electrical Panels, Platforms, and Equipment)		
Interior Dry Areas	Anchor material type to be stainless steel	Verify product acceptability and manufacturer's requirements if anchor installation will occur in an overhead application
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel adhesive anchors	Verify product acceptability and manufacturer's requirements if anchor installation will occur in an overhead application
2. All Others		
All service uses and locations	Stainless steel fasteners	

B. Antiseizing Lubricant: Use on all stainless steel threads.

C. Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.

END OF SECTION

SECTION 05 16 34
SEISMIC CABLING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM): A416/A416M, Standard Specification for Steel Strand, Uncoated Seven-Wire, for Prestressed Concrete.

1.02 SUBMITTALS

A. Action Submittals:

1. Product Data:
   a. Seismic cables.
   b. Sponge rubber sleeves.
   c. Glue for sponge rubber sleeves.
2. Details for seismic cables in-place in the structure.
3. Details of sponge rubber sleeves and sequence of installation.

B. Informational Submittals:

1. Fabrication and installation instructions.
2. Manufacturer's Certificate of Compliance in accordance with Section 01 61 00, Common Product Requirements, and including:
   a. Mill test data for cable prior to galvanizing.
   b. Chemical composition, physical properties, and dimensions of unit prior to galvanizing.
   c. Data for minimum of three Samples of final galvanized cables taken from actual material to be used on the Job.
   d. Tension test data for one of these three Samples from a local test laboratory showing the stress-strain curve with the ultimate tensile strength and yield stress at 1 percent offset marked on a certified Submittal.

PART 2 PRODUCTS

2.01 EARTHQUAKE CABLES

A. Fabricate from seven-wire stress-relieved galvanized prestressing strands:

1. Strands: Conform to ASTM A416/A416M, Grade 270, prior to being hot-dipped galvanized.

2. Zinc Coating: 0.85 ounce per square foot minimum weight.
3. Elongation: Minimum 4.5 percent in a 24-inch gauge length.
4. After galvanizing, strands shall meet or exceed the following minimum properties:

	0.50-inch Diameter
Net area (square inches)	0.153
Breaking strength (pounds)	38,200
Yield strength at 1 percent offset (pounds)	28,700

2.02 SPONGE RUBBER SLEEVES

A. Closed cellular neoprene.

B. Manufacturers and Products:

1. Monmouth Rubber & Plastics Corp., Long Branch, NJ; Durafoam DK2121MD.
2. Monarch Rubber Co., Baltimore, MD; Neoprene Blend F005013.
3. Rubatex, International, LLC, Bedford, VA; R-431-N or R-423-N Soft Grade.

C. Glue for Sponge Rubber Sleeves: Furnish manufacturer's standard neoprene contact glue.

2.03 SOURCE QUALITY CONTROL

A. Fabrication:

1. Engineer approved method and as shown.
2. Cut sponge sleeves and cable recesses as required.
3. Cut undersized cable recesses and insert cables so voids do not remain inside sleeve.
4. Glue sleeves back together to provide a sleeve that will not come apart during handling or construction.
5. Shop fabricate and shape seismic cable sleeve sections to dimensions required prior to placement in forms. Spacing between cables and from end cable to end of sleeve shall be as required by sleeve supplier based on cable size and number. Dimensions may be varied from those shown on Drawings to provide geometry standard to supplier if approved by Engineer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Place cables in base joint.

B. Tie securely in-place as shown on Drawings.

C. Install cables to penetrate joints between wall and footing at angle shown on Drawings.

D. Completed Installation: Inspected by Special Inspector and by Engineer prior to placing concrete.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. The Aluminum Association, Inc. (AA): The Aluminum Design Manual.
2. American Galvanizers Association (AGA):
   a. Inspection of Hot-Dip Galvanized Steel Products.
   b. Quality Assurance Manual.
3. American Iron and Steel Institute (AISI): Stainless Steel Types.
4. American Ladder Institute (ALI): A14.3, Ladders - Fixed - Safety Requirements.
5. American National Standards Institute (ANSI).
6. American Society of Safety Engineers (ASSE): A10.11, Safety Requirements for Personnel and Debris Nets.
7. American Welding Society (AWS):
   a. D1.1/D1.1M, Structural Welding Code - Steel.
   b. D1.2/D1.2M, Structural Welding Code - Aluminum.
   c. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
8. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A48/A48M, Specification for Gray Iron Castings.
   c. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   d. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
   e. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   f. A143/A143M, Standard for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
   g. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   h. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
   i. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

j. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
k. A276, Standard Specification for Stainless Steel Bars and Shapes.
l. A283/A283M, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
m. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
n. A325, Standard Specification for Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.
o. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
p. A384/A384M, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
q. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
r. A489, Standard Specification for Carbon Steel Lifting Eyes.
s. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
t. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
u. A563, Standard Specification for Carbon and Alloy Steel Nuts.
v. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
w. A780/A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
x. A786/A786M, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
y. A793, Standard Specification for Rolled Floor Plate, Stainless Steel.
z. A967, Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
aa. A992/A992M, Standard Specification for Structural Steel Shapes.
bb. A1085, Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
cc. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
dd. B308/B308M, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
ee. B429/B429M, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

ff. B632/B632M, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
gg. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
hh. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
ii. F436, Standard Specification for Hardened Steel Washers.
jj. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
kk. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
ll. F594, Standard Specification for Stainless Steel Nuts.
mm. F844, Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
nn. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

9. NSF International (NSF): 61, Drinking Water System Components-Health Effects.
10. Occupational Safety and Health Administration (OSHA):
    a. 29 CFR 1910.27, Fixed Ladders.
    b. 29 CFR 1926.105, Safety Nets.
    c. 29 CFR 1926.502, Fall Protection Systems Criteria and Practices.
11. Specialty Steel Industry of North America (SSINA):
    a. Specifications for Stainless Steel.
    b. Design Guidelines for the Selection and Use of Stainless Steel.
    c. Stainless Steel Fabrication.
    d. Stainless Steel Fasteners.

1.02 DEFINITIONS

A. Anchor Bolt: Cast-in-place anchor; concrete or masonry.

B. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.

C. Exterior Area: Location not protected from weather by building or other enclosed structure.

D. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or washdown, nor where wall or roof slab is common to a water-holding or earth-retaining structure.

E. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or washdown, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.

F. Submerged: Location at or below top of wall of open water-holding structure, such as basin or channel, or wall, ceiling or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Metal fabrications, including welding and fastener information.
2. Samples: Color samples of abrasive stair nosings.

B. Informational Submittals: Passivation method for stainless steel members.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Insofar as practical, factory assemble specified items. Package assemblies, which have to be shipped unassembled to protect materials from damage and tag to facilitate identification and field assembly.

B. Package stainless steel items to provide protection from carbon impregnation.

C. Protect painted coatings and hot-dip galvanized finishes from damage as a result of metal banding and rough handling. Use padded slings and straps.

D. Store fabricated items in dry area, not in direct contact with ground.

1.06 SPECIAL GUARANTEE

A. Manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at option of Owner, removal and replacement of hatches and sidewalk doors found defective during a period of 5 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in General Conditions.

PART 2 PRODUCTS

2.01 GENERAL

A. For hot-dip galvanized steel that is exposed to view and does not receive paint, limit the combined phosphorus and silicon content to 0.04 percent. For steels that require a minimum of 0.15 percent silicon (such as plates over 1.5 inches thick for ASTM A36/A36M steel), limit maximum silicon content to 0.21 percent and phosphorous content to 0.03 percent.

B. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Steel Wide Flange Shapes	A992/992M
Other Steel Shapes and Plates	A36/A36M or A572/A572M, Grade 50 or A992/A992M for other steel shapes
Steel Pipe	A500, Grade B
Hollow Structural Sections (HSS)	A500/A500M, Grade C
Aluminum:	
Aluminum Plates	B209, Alloy y6061-T6
Aluminum Structural Shapes	B308/B308M, Alloy 6061-T6
Stainless Steel:	
Bars and Angles	A276, AISI Type 316 (316L for welded connections)
Shapes	A276, AISI Type 304 (304L for welded connections)
Steel Plate, Sheet, and Strip	A240/A240M, AISI Type 316 (316L for welded connections)

Item	ASTM Reference
Bolts, Threaded Rods, Anchor Bolts, and Anchor Studs	F593, AISI Type 316, Group 2, Condition SH
Nuts	F594, AISI Type 316, Condition CW
Steel Bolts and Nuts:	
Carbon Steel	A307 bolts, with A563 nuts
High-Strength	A325, Type 1 bolts, with A563 nuts
Anchor Bolts and Rods	F1554, Grade 55, with weldability supplement S1.
Eyebolts	A489
Threaded Rods	A36/A36M
Flat Washers (Unhardened)	F844
Flat and Beveled Washers (Hardened)	F436
Thrust Ties for Steel Pipe:	
Threaded Rods	A193/A193M, Grade B7
Nuts	A194/A194M, Grade 2H
Plate	A283/A283M, Grade D
Welded Anchor Studs	A108, Grades C-1010 through C-1020
Aluminum Bolts and Nuts	F468, Alloy 2024-T4
Cast Iron	A48/A48M, Class 35

C. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, zinc-plated steel, and aluminum material types as indicated in Fastener Schedule at end of this section.

2.02 ANCHOR BOLTS AND ANCHOR BOLT SLEEVES

A. Cast-In-Place Anchor Bolts:

1. Headed type, unless otherwise shown on Drawings.
2. Material type and protective coating as shown in Fastener Schedule at end of this section.

B. Anchor Bolt Sleeves:

1. Plastic:
   a. Single unit construction with corrugated sleeve.
   b. Top of sleeve shall be self-threading to provide adjustment of threaded anchor bolt projection.
   c. Material: High-density polyethylene.
2. Fabricated Steel: ASTM A36/A36M.

2.03 POST-INSTALLED CONCRETE AND MASONRY ANCHORS

A. See Section 05 05 19, Post-Installed Anchors.

2.04 PIPE SLEEVES

A. As indicted on Drawing Standard Details.

2.05 EMBEDDED STEEL SUPPORT FRAMES FOR GRATING

A. Steel angle support frames to be embedded in concrete shall be stainless steel, ASTM A276, AISI Type 316, unless indicated otherwise.

B. Welded anchors for stainless steel support frames shall also be stainless steel.

2.06 ABRASIVE NOSING FOR STAIRS

A. Unless otherwise shown on Drawings, furnish flush type abrasive nosings on stairs.

B. Nosing Components:

1. Homogeneous epoxy abrasive, with minimum 50 percent aluminum oxide content, formed and cured upon an extruded aluminum base.
2. Epoxy abrasive shall extend over and form curved front edge of nosing.
3. Base of Nosing: Extruded aluminum alloy, 6063-T5, heat-treated.

C. Anchoring System: Double-set anchors consisting of two rows of integrally extruded anchors.

D. Size: 3 inches wide by 1/4 inch to 3/8 inch thick by length as shown.

E. Color: Selected by Engineer from manufacturer’s standard color range.

F. Manufacturers and Products:

1. Wooster Products, Inc., Wooster, OH; Spectra Type WP3J and Spectra Type WP3C.
2. American Safety Tread Co., Inc., Helena, AL; Type BF-311D and Type FA-311D.

2.07 HATCHES (RESERVOIR)

A. Load Capacity: 75 psf with maximum deflection of 1/150th of span.

B. Component Fabrication:

1. Access Door Leaf(s): Minimum1/4-inch-thick aluminum diamond pattern plate. Provide stainless steel safety chain and attachments for end of double-leaf door assembly when open.
2. Angle Frame: Minimum 1/4-inch thick extruded aluminum angle frame with concrete anchors and integral neoprene gasket strip.

C. Safety Grate (Where shown on Drawings): Stainless Steel grating with 300 psf live load capacity.

D. Door Hardware:

1. Hinges: Heavy-duty stainless steel with stainless steel pins, through-bolted to cover plate with tamper-proof stainless steel bolts flush with cover and to outside leg of frame with stainless steel bolts and locknuts. No penetrations allowed in top of cover.
2. Lifting Mechanism: Stainless steel compression lift springs enclosed in telescoping vertical housing or stainless steel torsion lift springs.
3. Hold-Open Arm:
   a. Locks automatically in open position.
   b. Disengages with slight pull on vinyl grip with one hand.
   c. Door can be easily closed with one hand by pulling forward and down on vinyl grip.
4. Lock: Padlock hasp on side of hatch cover.

E. Aluminum: Mill finished with protective coating applied to surfaces to be in contact with concrete, as specified in Section 09 90 00, Painting and Coating.

F. Manufacturers and Products:

1. Bilco Co., New Haven, CT; D Series.
2. EJ Co., Tooele, UT; FLN Series.
3. Nystrom Products Co., Minneapolis, MN; RHEA Series.
4. U.S.F. Fabrication, Hialeah, FL; FPS Series.

2.08 SIDEWALK DOORS (VAULTS)

A. Constructed with a channel frame for use in exterior applications.

B. Load Capacity: 300 psf with maximum deflection of 1/150th of span.

C. Component Fabrication:

1. Access Door Leaf(s): 1/4-inch aluminum diamond pattern plate. Provide stainless steel safety chain and attachments for end of double-leaf door assembly when open.
2. Channel Frame: 1/4-inch-thick extruded aluminum trough frame with continuous anchor flange around perimeter. Weld 1-1/2-inch diameter drain coupling, and drain pipe, to frame trough at front right corner, unless indicated otherwise on Drawings.
3. Safety Grate: Aluminum grating with 300 psf live load capacity, 5-inch by 5-inch grate openings, permanent hinging system that locks grate in 90-degree position, and opening arm with vinyl grip handle and locking device.

D. Door Hardware:

1. Hinges: Heavy-duty stainless steel with stainless steel pins through-bolted to cover plate with tamper-proof stainless steel bolts flush with top of cover and to outside leg of channel frame with stainless steel bolts and locknuts.
2. Lifting Mechanism: Stainless steel compression lift springs enclosed in telescoping vertical housing or stainless steel torsion lift springs.
3. Hold-Open Arm:
   a. Locks automatically in open position.
   b. Disengages with slight pull on vinyl grip with one hand.
   c. Door can be easily closed with one hand by pulling forward and down on vinyl grip.
4. Snap Lock:
   a. Stainless steel snap lock mounted on bottom of door leaf with removable topside key wrench and inside fixed lever handle.
   b. Threaded plug for flush outside surface with key wrench removed.

E. Aluminum: Mill finished with protective coating applied to surfaces to be in contact with concrete, as specified in Section 09 90 00, Painting and Coating.

F. Manufacturers and Products:

1. Bilco Co., New Haven, CT; J Series.
2. EJ Co., Tooele, UT; CLS Series.
3. Nystrom Products Co., Minneapolis, MN; FG Series.
4. U.S.F. Fabrication, Hialeah, FL; T Series.
5. ITT Flygt Corporation, Trumbull, CT; FDRN Series.
6. Thompson Fabricating Co., Birmingham, AL; TE Series.
7. Halliday Products, Orlando, FL; WS Series.

2.09 LADDERS

A. Fabricate ladders with rails, rungs, landings, and cages to meet applicable requirements of OSHA, CFR Part 1910.27, and ALI A14.3.

B. Flat Bar Ladder:

1. Punch rails, pass rungs through rails, and weld on outside.
2. Weld brackets to ladder for fastening ladder to wall.
3. ASTM A276, AISI Type 316L stainless steel.

C. Pipe Ladder:

1. Rungs: McNichols Small Hole Traction Tread, 1-5/8 inch stainless steel.
2. Side Rails: Stainless Steel Type 316 (Reservoir) or Type 304 (Vaults), 1-1/2 inches, Schedule 40 pipe.
3. Ladder Attachments: Stainless steel, type to match ladder rails.
4. Furnish support attachments to side rails at 3 feet maximum spacing.

D. Ladder Safety Post:

1. Telescoping tubular, spring balanced and automatically locking in raised position, with release lever for unlocking.
2. Post: Stainless steel, AISI Type 304.
3. Hardware: Stainless steel, AISI Type 316.
4. Manufacturer and Product: Bilco Co., New Haven, CT; “Ladder Up” to fit ladder rungs.

2.10 FABRICATED UNITS

A. Overflow Pipe and Accessories:

1. Use stainless steel pipe and fabricate flared section at top of overflow of stainless steel plate, weld seams, and grind smooth.

2. Flange at Base:
    a. Standard 125-pound steel ring flange drilled 125-pound ANSI Standard.
    b. Flange: Parallel to upper edge of fitting so lip can be installed in horizontal plane with pipe vertical.
    c. Grind upper lip smooth.
3. Fabricate supporting brackets of structural shapes and flat bar stock, as shown.

2.11 ACCESSORIES

A. Antiseizing Lubricant for Stainless Steel Threaded Connections:

1. Suitable for potable water supply.
2. Resists washout.
3. Manufacturers and Products:
    a. Bostik, Middleton, MA; Neverseez.
    b. Saf-T-Eze Div., STL Corp., Lombard, IL; Anti-Seize.

B. Neoprene Gasket:

1. ASTM D1056, 2C1, soft, closed-cell neoprene gasket material, suitable for exposure to potable water, unless otherwise shown on Drawings.
2. Thickness: Minimum 1/4 inch.
3. Furnish without skin coat.
4. Manufacturer and Product: Monmouth Rubber and Plastics Corporation, Long Branch, NJ; Durafoam DK1111LD.

2.12 FABRICATION

A. General:

1. Finish exposed surfaces smooth, sharp, and to well-defined lines.
2. Furnish necessary rabbets, lugs, and brackets so work can be assembled in neat, substantial manner.
3. Conceal fastenings where practical; where exposed, flush countersink.
4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Grind cut edges smooth and straight. Round sharp edges to small uniform radius. Grind burrs, jagged edges, and surface defects smooth.
6. Fit and assemble in largest practical sections for delivery to Site.
7. Stainless steel fabrication shall be done such that impregnation with carbon steel does not occur.

B. Materials:

1. Use steel shapes, unless otherwise noted.
2. Steel to be hot-dip galvanized: Limit silicon content to less than 0.04 percent or to between 0.15 percent and 0.25 percent.
3. Fabricate aluminum in accordance with AA Specifications for Aluminum Structures–Allowable Stress Design.

C. Welding:

1. Weld connections and grind exposed welds smooth. When required to be watertight, make welds continuous.
2. Welded fabrications shall be free from twisting or distortion caused by improper welding techniques.
3. Steel: Meet fabrication requirements of AWS D1.1/D1.1M, Section 5.
4. Aluminum: Meet requirements of AWS D1.2/D1.2M.
5. Stainless Steel: Meet requirements of AWS D1.6/D1.6M.
6. Welded Anchor Studs: Prepare surface to be welded and weld with stud welding gun in accordance with AWS D1.1/D1.1M, Section 7, and manufacturer's instructions.
7. Complete welding before applying finish.

D. Painting:

1. Shop prime with rust-inhibitive primer as specified in Section 09 90 00, Painting and Coating, unless otherwise indicated.
2. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
3. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.

E. Galvanizing:

1. Fabricate steel to be galvanized in accordance with ASTM A143/A143M, ASTM A384/A384M, and ASTM A385/A385M. Avoid fabrication techniques that could cause distortion or embrittlement of the steel.
2. Provide venting and drain holes for tubular members and fabricated assemblies in accordance with ASTM A385/A385M.
3. Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.
4. Remove by blast cleaning or other methods surface contaminants and coatings not removable by normal chemical cleaning process in the galvanizing operation.

5. Hot-dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123/A123M.
6. Hot-dip galvanize bolts, nuts, washers, and hardware components in accordance with ASTM A153/A153M. Oversize holes to allow for zinc alloy growth. Shop assemble bolts and nuts.
7. Galvanized steel sheets in accordance with ASTM A653/A653M.
8. Galvanize components of bolted assemblies separately before assembly. Galvanizing of tapped holes is not required.

F. Electrolytic Protection: Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.

G. Watertight Seal: Where required or shown, furnish neoprene gasket of a type that is satisfactory for use in contact with potable water. Cover full bearing surfaces.

H. Fitting: Where movement of fabrications is required or shown, cut, fit, and align items for smooth operation. Make corners square and opposite sides parallel.

I. Accessories: Furnish as required for a complete installation. Fasten by welding or with stainless steel bolts or screws.

2.13 SOURCE QUALITY CONTROL

A. Visually inspect all fabrication welds and correct deficiencies.

1. Steel: AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.
2. Aluminum: AWS D1.2/D1.2M.
3. Stainless Steel: AWS D1.6/D1.6M.

PART 3 EXECUTION

3.01 INSTALLATION OF METAL FABRICATIONS

A. General:

1. Install metal fabrications plumb and level, accurately fitted, free from distortion or defects.
2. Install rigid, substantial, and neat in appearance.

3. Install manufactured products in accordance with manufacturer's recommendations.
4. Obtain Engineer approval prior to field cutting steel members or making adjustments not scheduled.

B. Aluminum:

1. Do not remove mill markings from concealed surfaces.
2. Remove inked or painted identification marks on exposed surfaces not otherwise coated after installed material has been inspected and approved.
3. Fabrication, mechanical connections, and welded construction shall be in accordance with the AA Aluminum Design Manual.

C. Pipe Sleeves:

1. Provide where pipes pass through concrete or masonry.
2. Holes drilled with a rotary drill may be provided in lieu of sleeves in existing walls.
3. Provide center flange for water stoppage on sleeves in exterior or water-bearing walls.
4. Provide rubber caulking sealant or a modular mechanical unit to form watertight seal in annular space between pipes and sleeves.

3.02 CAST-IN-PLACE ANCHOR BOLTS

A. Locate and hold anchor bolts in place with templates at time concrete is placed.

B. Use anchor bolt sleeves for location adjustment and provide two nuts and one washer per bolt of same material as bolt.

C. Minimum Bolt Size: 1/2-inch diameter by 12 inches long, unless otherwise shown.

3.03 ABRASIVE NOSINGS

A. Provide abrasive nosings on concrete steps except inside the reservoir.

3.04 ACCESS COVERS

A. Install access covers, including sidewalk doors, floor hatches, and hinged manhole covers in accordance with manufacturer's instructions.

B. Accurately position prior to placing concrete, such that covers are flush with floor surface.

C. Protect from damage resulting from concrete placement. Thoroughly clean exposed surfaces of concrete spillage to obtain a clean, uniform appearance.

D. Position cover so that hinge is on side opposite ladder.

3.05 ELECTROLYTIC PROTECTION

A. Aluminum and Galvanized Steel:

1. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
2. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.
3. Allow coating to dry before installation of the material.
4. Protect coated surfaces during installation.
5. Should coating become marred, prepare and touch up in accordance with paint manufacturer’s written instructions.

B. Stainless Steel:

1. During handling and installation, take necessary precautions to prevent carbon impregnation of stainless steel members.
2. After installation, visually inspect stainless steel surfaces for evidence of iron rust, oil, paint, and other forms of contamination.
3. Remove contamination using cleaning and passivation methods in accordance with requirements of ASTM A380 and ASTM A967.
4. Brushes used to remove foreign substances shall utilize only stainless steel or nonmetallic bristles.
5. After treatment, visually inspect surfaces for compliance.

3.06 PAINTING

A. Painted Galvanized Surfaces: Prepare as specified in Section 09 90 00, Painting and Coating.

B. Repair of Damaged Hot-Dip Galvanized Coating:

1. Conform to ASTM A780/A780M.
2. For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780/A780M.
3. For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A780/A780M.
4. Use magnetic gauge to determine thickness is equal to or greater than base galvanized coating.

3.07 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance:

1. In accordance with IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing.
2. Contractor responsibilities and related information on special inspection, observation, and testing are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control:

1. Inspection and testing required in Section 01 45 16.13, Contractor Quality Control.
2. Manufacturer's Certificate of Compliance per Section 01 61 00, Common Product Requirements, for test results, or calculations, or drawings that ensure material and equipment design and design criteria meet requirements of Section 01 61 00, Common Product Requirements, and Section 01 88 15, Anchorage and Bracing.
3. Special inspection shall be provided by Owner where indicated in Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing.

3.08 FASTENER SCHEDULE

A. Unless indicated otherwise on Drawings, provide fasteners as follows:

Service Use and Location	**Product**	**Remarks**
1. Anchor Bolts Cast Into Concrete for Structural Steel, Metal Fabrications and Castings		
Interior Dry Areas	Hot-dip galvanized steel headed anchor bolts, unless indicated otherwise	
Exterior and Interior Wet Areas	Stainless steel headed anchor bolts	
Submerged and Corrosive Areas	Stainless steel headed anchor bolts with fusion bonded coating	See Section 09 90 00, Painting and Coating

Service Use and Location	Product	Remarks
2. Anchor Bolts Cast Into Concrete for Equipment Bases		
Interior Dry Areas	Stainless steel headed anchor bolts, unless otherwise specified with equipment	
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel headed anchor bolts with fusion bonded coating, unless otherwise specified with equipment	See Section 09 90 00, Painting and Coating
3. Post-Installed Anchors: See Section 05 05 19, Post-Installed Anchors		
		Use hot-dipped galvanized high-strength bolted connections for galvanized steel framing members.
4. Connections of Aluminum Components		
Submerged, Exterior and Interior Wet and Dry Areas	Stainless steel bolted connections, unless otherwise specified with equipment	
5. All Others		
Exterior and Interior Wet and Dry Areas	Stainless steel fasteners	

B. Antiseizing Lubricant: Use on stainless steel threads.

END OF SECTION

SECTION 05 52 19
STEEL RAILINGS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Iron and Steel Institute (AISI): As applicable.
2. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   c. A276, Standard Specification for Stainless Steel Bars and Shapes.
   d. A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
   e. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   f. E894, Standard Test method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
   g. E935, Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
   h. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
3. International Code Council (ICC):
   a. 2021 International Building Code (IBC).
   b. Evaluation Services Reports, as applicable.
4. Occupational Safety and Health Act (OSHA): 29 CFR 1910, Code of Federal Regulations.

1.02 DEFINITIONS

A. ICC Evaluation Services Report: ICC report on evaluation of manufactured concrete anchor systems.

B. Railings: This term shall include guardrail systems, handrail systems, platform railing systems, ramp-rail systems, and stair-rail systems. Railings may be comprised of a framework of vertical, horizontal, or inclined members, grillwork or panels, accessories, or combination thereof.

C. Special Inspection: As defined by the ICC IBC.

D. Toeboards: Vertical barrier at floor level usually erected on railings along exposed edges of floor or wall openings, platforms, or ramps to prevent miscellaneous items from falling through.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Project-specific scaled plans and elevations of railings and detail drawings. Include railing profiles, sizes, connections, anchorage, size and type of fasteners, and accessories.
   b. Manufacturer's literature and catalog data of railing and components.
   c. Design Data: Where proposed design of post base connections is different than details shown on Drawings, submit calculations or test data for alternate railing anchorages using ICC IBC design loads.
2. Samples:
   a. Rail sections, 6 inches long, showing each type of proposed connection, proposed finish, and workmanship.
   b. Each fitting, including wall brackets, castings, toeboard, and rail expansion joints.

B. Informational Submittals:

1. Manufacturer's assembly and installation instructions.
2. Special Inspection: Manufacturer's instructions for Special Inspection of post-installed concrete anchors.
3. Test Reports: Test data for anchorages may supplement design data submitted for alternate anchorage details. Testing of anchorages shall be in accordance with ASTM E894 and ASTM E935 using applied loads in accordance with the ICC IBC.

1.04 QUALITY ASSURANCE

A. Qualifications: Calculations required for alternate anchorage designs (if proposed) shall be stamped by a registered civil or structural engineer licensed in the state where the Project will be constructed.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Railings adequately packaged and wrapped to prevent scratching and denting during shipment, storage, and installation. Maintain protective wrapping to the extent possible until railing is completely installed.

PART 2 PRODUCTS

2.01 STAINLESS STEEL RAILINGS

A. Pipe Railings/Round HSS:

1. Stainless steel, ASTM A276 Type 316 (Type 316L where welded).
2. Outside Diameter: 1.900-inch.
3. Wall Thickness:
   a. Rail: 0.145-inch, minimum.
   b. Post: 0.200-inch, minimum.

B. Accessories, including railing components, flanges, wall brackets, anchor plates, shall conform to the following:

1. Post Bolted Baseplate: Stainless steel ASTM A276 Type 316 (Type 316L where welded).
2. Wall Brackets: Type 316 stainless steel.
3. Rail Terminals (including Wall Returns): Round, stainless steel, welded to rail, with two 5/16-inch holes for 1/4-inch fasteners.
4. Toeboards and Accessories:
   a. ASTM A276 Type 316 stainless steel.
   b. Toeboards: Provide slotted holes for expansion and contraction where required.
   c. Fasteners: Stainless steel.

C. Miscellaneous Fasteners: Stainless steel.

2.02 ANCHOR BOLTS, FASTENERS, AND CONCRETE ANCHORS

A. Locknuts, Washers, and Screws:

1. Elastic Locknuts, Steel Flat Washers, Round Head Machine Screws (RHMS): Stainless steel.
2. Flat Washers: Molded nylon.

B. Bolts and Nuts for Bolting Railing to Metal Beams: Type 316 stainless steel.

C. Concrete Anchors:

1. Post-installed anchors shall be in accordance with Section 05 05 19, Post-Installed Anchors, unless otherwise specified herein.
2. Bolt Diameter: 1/2 inch, minimum.

2.03 FABRICATION OF WELDED STAINLESS STEEL RAILINGS

A. Shop Assembly:

1. Post spacing and railing details shall be as shown on Drawings.
2. Post to Baseplate Connection: Field fit-up is required as shown on Drawings.
3. Alternate Post to Baseplate Connection:
   a. Field measure elevation of concrete at each post location and determine exact post length so baseplate is on concrete surface.
   b. Rails shall be in straight alignment when rails to posts and posts to baseplates are welded.
   c. Field weld posts to baseplates.
4. Remove burrs from cut edges.
5. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with finished surfaces smooth.
6. Cover exposed ends of steel pipe by welding 1/8-inch minimum thickness plate in place or use prefabricated fittings.
7. Welding:
   a. Thoroughly fuse without undercutting or overlap.
   b. Remove splatter, grind exposed welds to blend, and contour surfaces to match those adjacent.
8. Furnish explosion prevention holes at closed ends of pipes.
9. Form and assemble joints exposed to weather to prevent water and moisture from penetrating.
10. Passivate all stainless steel after fabrication.

B. Tolerances:

1. Cut pipe square within 2 degrees and lengths within 1/8 inch.
2. Welding: Miter and cope intersections of posts and rails within 2 degrees, fit to within 0.020 inch, and perform continuous welds around joints.

C. Repair of Defective Work: Remove stains and replace defective Work.

PART 3 EXECUTION

3.01 GENERAL

A. Where required, provide railing posts longer than needed and field cut to exact dimensions required in order to satisfy vertical variations on actual structure.

B. Install railing with base that provides plus or minus 1/4-inch vertical adjustment inside base fitting. If adjustment is required in field and exceeds plus or minus 1/4-inch, reduce post length not to exceed beyond bottom of lowest set-screw or bolt in base fitting.

C. Modification to supporting structure is not permitted where railing is to be attached.

D. Protection from Entrapped Water:

1. Make provisions in exterior and interior installations subject to high humidity to drain water from railing system.
2. For posts mounted in concrete, bends, and elbows occurring at low points drill weep holes of 1/4-inch diameter at lowest possible elevations, one hole per post or rail. Drill hole in plane of rail.

3.02 RAILING INSTALLATION

A. Expansion Joints:

1. Maximum intervals of 54 feet on center and at structural movement joints.
2. Slip joint with internal sleeve extending 2 inches beyond each side of joint. Provide 1/2-inch slip joint gap to allow for expansion.
3. Fasten to one side using 3/8-inch diameter set-screw. Place set-screw at bottom of pipe.
4. Locate joints within 12 inches of posts. Locate expansion joints in rails that span movement joints in structural walls and floors supporting the posts.

B. Posts and Rails:

1. Surface Mounted and Side Mounted Posts:
   a. Bolt post baseplate connectors firmly in place.
   b. Install to account for small variation in leveling grouts and shims between adjacent posts.
2. Set posts plumb and aligned to within 1/8 inch in 12 feet.
3. Set rails horizontal or parallel to slope of steps to within 1/8 inch in 12 feet.
4. Install posts and rails in same plane.
5. Remove projections or irregularities and provide a smooth surface for sliding hands continuously along top rail.
6. Use offset rail for use on stairs and platforms if post is attached to web of stringers or structural platform supports.
7. Support 1-1/2-inch rails directly above stairway stringers with offset fittings.

C. Wall Brackets: Support wall rails on brackets as shown on Drawings.

D. Toeboard:

1. Provide at railings, except where 4-inch or higher concrete curbs are installed, at gates, or on stairways unless shown otherwise.
2. Accurately measure in field for correct length; after railing post installation, cut and secure to posts.
3. Dimension between bottom of toeboard and walking surface not to exceed 1/4 inch.
4. Install plumb and aligned to within 1/8 inch in 12 feet.

3.03 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Post-installed anchors supporting railing systems require special inspection.

B. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

C. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

3.04 CLEANING

A. Wash railing system thoroughly using clean water and soap. Rinse with clean water.

END OF SECTION

SECTION 05 53 00
METAL GRATINGS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): Standard Specifications for Highway Bridges.
2. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   c. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
   d. B210, Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
   e. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
3. National Association of Architectural Metal Manufacturers (NAAMM):
   a. MBG 531, Metal Bar Grating Manual.
   b. MBG 532, Heavy-Duty Metal Bar Grating Manual.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Grating: Show dimensions, weight, size, and location of connections to adjacent grating, supports, and other Work.
   b. Grating Anchorage: Show details of anchorage to supports to prevent displacement from traffic impact.
   c. Product data for grating, grating clips, anchors, accessories, and other manufactured products specified herein.
   d. Manufacturer’s specifications, including coatings, surface treatment, and finishes.

B. Informational Submittals:

1. Special handling and storage requirements.
2. Installation instructions.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Insofar as is practical, factory assemble items.

B. Package and clearly tag parts and assemblies that are, due to necessity, shipped unassembled.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Alabama Metal Industries Corporation (AMICO), Birmingham, AL.
2. IKG, Houston, TX.
3. Ohio Gratings, Inc., Canton, OH.

2.02 GRATING MATERIALS

A. Stainless Steel:

1. Bearing Bars, Banding, and Cross Bars: ASTM A666, Type 316L.
2. Finish: Mill.

2.03 LIGHT AND MEDIUM-DUTY METAL BAR GRATING (TYPE A AND B)

A. General Requirements:

1. Maximum Service Load:
   a. Light Duty (Type A): 100 psf uniformly distributed load.
   b. Medium Duty (Type B): 500 psf uniformly distributed load.
2. Maximum Deflection: Span/240 or 1/4 inch, whichever is less.
3. Bearing Bar Spacing:
   a. Light Duty: 1-3/16-inch maximum, center-to-center.
   b. Medium Duty: 15/16 inch maximum, center-to-center.
4. Cross Bar Spacing: 4 inches maximum, center-to-center.
5. Bearing Bars, Cross Bars and Banding: Minimum thickness as specified in NAAMM MBG 531 or as shown on Drawings.

B. Grating Materials: Stainless steel pressure-locked rectangular bar grating fabricated by swaging crossbars between rectangular bearing bars or welded, rectangular bar grating fabricated by welding cross bars to bearing bars.

C. Surface: Plain.

D. Stair Treads:

1. Material and Type: Same as grating material and grating type as furnished for connecting walkway or work surface.
2. Nosings: Integral ribbing and serrated edge on one long axis of tread, or nonslip abrasive on each tread along one long edge.
3. Carrier Plate or Angle: Furnish at each end for connection to stair stringers.

2.04 ACCESSORIES

A. Embedded Frames: As indicated on Drawings and as specified in Section 05 50 00, Metal Fabrications.

B. Grating Clamps:

1. Use at flanged beam and bolted angle frame supports.
2. Removable from above grating walkway surface.
3. Provide hat bracket, recessed bolt, and bottom clamp of same material as grating.
4. Manufacturers and Products:
   a. Direct Metals Company, LLC, Kennesaw, GA; Grating Clamp.
   b. Grating Fasteners, Inc., Harvey, LA; G-Clip.

C. Anchor Stud and Saddle Clip:

1. Use at embedded angle frame supports with stud anchor and nut recessed below top of grating surface.
2. Removable from above grating walkway surface.
3. Provide Type 316 stainless steel welded threaded stud anchor, nut, washer, and saddle clip.
4. Manufacturers and Products:
   a. Welded Stud Anchor:
      1) Nelson Stud Welding, Inc., Elyria, OH.
      2) Stud Welding Associates, Inc. Elyria, OH.
   b. Saddle Clip:
      1) Direct Metals Company, LLC, Kennesaw, GA; Saddle Clip.
      2) Grating Fasteners, Inc., Harvey, LA; Saddle Clip.
      3) Struct-Fast, Inc., Baltimore, MD; Gratefast.

2.05 FABRICATION

A. General:

1. In accordance with NAAMM MBG 531 or NAAMM MBG 532.
2. Conceal fastenings where practical.

3. Drill metalwork and countersink holes as required for attaching hardware or other materials.
4. Cutouts:
   a. Fabricate in grating sections for penetrations indicated.
   b. Arrange to permit grating removal without disturbing items penetrating grating.
   c. Edge band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
5. Do not notch bearing bars at supports to maintain elevation.
6. Field measure areas to receive grating. Verify dimensions of new fabricated supports, and fabricate to dimension required for specified clearances.
7. Section Length: Sufficient to prevent section from falling through clear opening when oriented in the span direction and one end is touching either the concrete or the vertical leg of grating support.
8. Minimum Bearing: 1 inch for grating depth up to 2-1/4 inches and 2 inches for grating depth greater than 2-1/4 inches.
9. Banding and Toe Plates: Same material as grating and welded to bearing bars in accordance with requirements of NAAMM MBG 531 and NAAMM MBG 532.

B. Light and Medium-Duty Metal Bar Grating: A single grating section shall be not less than 1.5 feet or greater than 3 feet in width, or weigh more than 150 pounds.

C. Supports:

1. Same material as grating, except that supports which are to be embedded in concrete shall be Type 316 stainless steel, unless part of an extruded aluminum system.
2. Coordinate dimensions and fabrication with grating to be supported.

PART 3 EXECUTION

3.01 INSTALLATION

A. Until grating sections are securely fastened in place, area shall be appropriately barricaded or flagged to alert people working in the area of potential fall hazard.

B. Install manufactured products in accordance with manufacturer’s recommendations.

C. Install supports such that grating sections have a solid bearing on both ends, and that grating sections will not rock or wobble under design loads.

D. Install grating supports plumb and level as applicable.

E. Install sections of welded frames with anchors to straight plane without offsets.

F. Field locate and install fasteners to fit grating layout.

G. Anchor grating securely to supports using minimum of four fastener clips and bolts per grating section.

H. Each grating section shall be easily removable and replaceable.

I. Completed installation shall be rigid and neat in appearance.

END OF SECTION

SECTION 07 21 01
THERMAL INSULATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Use rigid insulation where shown on Drawings, including 2-inch thick insulation on all vaults as shown on Drawings.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
   b. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

1.03 DELIVERY, STORAGE, AND HANDLING

A. On packaging clearly identify manufacturer, contents, brand name, applicable standard, and R-value. Store materials off ground and keep them dry at all times. Protect against weather, condensation, and damage.

1.04 SUBMIT PRODUCT DATA

A. Submit samples for each insulation that will be used with adhesive and fasteners.

PART 2 PRODUCTS

2.01 RIGID INSULATION

A. All rigid insulation in vaults that contain electrical equipment shall be aluminum faced unless noted otherwise on Drawings. Vaults that do not contain electrical equipment are required to have insulation but not be aluminum faced insulation.

B. Polyisocyanurate Rigid Foam Board Insulation:

1. ASTM C1289, Type II, Class 2, Grade 2.
2. Flame Spread: Less than 75 when tested in accordance with ASTM E84.
3. R-Value: 6.0 per inch of insulation minimum.

4. Smoke Development: Less than 450 when tested in accordance with ASTM E84.
5. Moisture Vapor Transmission: Less than 1.2 when tested in accordance with ASTM E96, Desiccant Method.
6. Compressive Strength: Meets or exceeds Type II when tested in accordance with ASTM C1289.
7. Water Absorption: Less than 1 percent by volume when tested in accordance with ASTM C209.
8. Dimensional Stability: Less than 1 percent linear change when tested in accordance with ASTM D2126.
9. Provide and install insulation with manufacturer recommended adhesives and Hilti insulation anchors/fasteners (IDP or IZ type).
10. Manufacturers:
    a. Dow Chemical Co.
    b. UC Industries (Owens Corning).
    c. Carlisle.
    d. Hunter Panels.

C. Adhesives and Fasteners: As recommended by insulation manufacturer.

PART 3 EXECUTION

3.01 INSTALLING RIGID INSULATION

A. Install insulation per manufacturer's written instructions. Use boards as large as practical.

B. Cut insulation with saw, knife, or other sharp tool to fit tightly around obstructions and at vent openings. Butt insulation boards together tightly at joints.

C. Apply to concrete walls, roof and beams. Do not apply behind ladders. Apply to steel and concrete perimeter of roof openings and to steel interior (bottom) of roof panels and hatches. Insulate around over and around steel reinforcing ribs.

D. Attach to concrete, steel, and other surfaces with adhesive recommended by manufacturer. Attach securely in place with manufacturer furnished adhesive and permanent mechanical fasteners. Boards shall be tested to fit tightly between all ribs on roof panels before adhesive is applied. Follow manufacturer's recommendations for preparing surfaces and applying adhesive and mechanical fasteners (Hilti IDP, IZ or X-IE 6 type).

END OF SECTION

SECTION 09 90 00
PAINTING AND COATING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
   a. C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines—Enamel and Tape—Hot-Applied.
   b. C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
   c. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
   d. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
2. Environmental Protection Agency (EPA).
3. NACE International (NACE): SP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
4. NSF International (NSF): 61, Drinking Water System Components-Health Effects.
5. Occupational Safety and Health Act (OSHA).
6. Research Council on Structural Connections (RCSC): Specification for Structural Joints using High-Strength Bolts.
7. The Society for Protective Coatings (SSPC):
   a. PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements.
   b. PA 10, Guide to Safety and Health Requirements for Industrial Painting Projects.
   c. SP 1, Solvent Cleaning.
   d. SP 2, Hand Tool Cleaning.
   e. SP 3, Power Tool Cleaning.
   f. SP 5, White Metal Blast Cleaning.
   g. SP 6, Commercial Blast Cleaning.
   h. SP 7, Joint Surface Preparation Standard Brush-Off Blast Cleaning.
   i. SP 10, Near-White Blast Cleaning.
   j. SP 11, Power Tool Cleaning to Bare Metal.
   k. SP 16, Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.

l. SP 13, Surface Preparation of Concrete.
m. Guide 15, Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates.

1.02 DEFINITIONS

A. Terms used in this section:

1. Coverage: Total minimum dry film thickness in mils or square feet per gallon.
2. FRP: Fiberglass Reinforced Plastic.
3. HCl: Hydrochloric Acid.
4. MDFT: Minimum Dry Film Thickness, mils.
5. MDFTPC: Minimum Dry Film Thickness per Coat, mils.
6. Mil: Thousandth of an inch.
7. PPDS: Paint Product Data Sheet.
8. PSDS: Paint System Data Sheet.
9. PVC: Polyvinyl Chloride.
10. SFPG: Square Feet per Gallon.
11. SFPGPC: Square Feet per Gallon per Coat.
12. SP: Surface Preparation.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Data Sheets:
      1) For each product, furnish a Paint Product Data Sheet (PPDS), the manufacturer’s technical data sheets, and paint colors available (where applicable). The PPDS form is appended to the end of this section.
      2) For each paint system, furnish a Paint System Data Sheet (PSDS). The PSDS form is appended to the end of this section.
      3) Technical and performance information that demonstrates compliance with specification.
      4) Furnish copies of paint system submittals to the coating applicator.
      5) Indiscriminate submittal of only manufacturer’s literature is not acceptable.
   b. Detailed chemical and gradation analysis for each proposed abrasive material.

2. Samples:
    a. Proposed Abrasive Materials: Minimum 5-pound sample for each type.
    b. Reference Panel:
        1) Surface Preparation:
            a) Prior to start of surface preparation, furnish a 4-inch by 4-inch steel panel for each grade of sandblast specified herein, prepared to specified requirements.
            b) Provide panel representative of the steel used; prevent deterioration of surface quality.
            c) Panel to be reference source for inspection upon approval by Engineer.
        2) Paint:
            a) Unless otherwise specified, before painting work is started, prepare minimum 8-inch by 10-inch sample with type of paint and application specified on similar substrate to which paint is to be applied.
            b) Furnish additional samples as required until colors, finishes, and textures are approved.
            c) Approved samples to be the quality standard for final finishes.

B. Informational Submittals:

1. Applicator’s Qualification: List of references substantiating experience.
2. Coating manufacturer’s Certificate of Compliance, in accordance with Section 01 43 33, Manufacturers’ Field Services.
3. Factory Applied Coatings: Manufacturer’s certification stating factory applied coating system meets or exceeds requirements specified.
4. Manufacturer’s written verification that submitted material is suitable for the intended use.
5. Coating for Faying Surfaces: Manufacturer’s test results that show the proposed coating meets the slip resistance requirements of the AISC Specification for Structural Joints using ASTM A325 or ASTM A490 bolts.
6. If the manufacturer of finish coating differs from that of shop primer, provide finish coating manufacturer’s written confirmation that materials are compatible.
7. Manufacturer’s written instructions and special details for applying each type of paint.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum 5 years' experience in application of specified products.

B. Regulatory Requirements:

1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.
2. Perform surface preparation and painting in accordance with recommendations of the following:
   a. Paint manufacturer's instructions.
   b. SSPC PA 10.
   c. Federal, state, and local agencies having jurisdiction.

C. Mockup:

1. Before proceeding with Work under this section, finish one complete space or item of each color scheme required showing selected colors, finish texture, materials, quality of work, and special details.
2. After Engineer approval, sample spaces or items shall serve as a standard for similar work throughout the Project.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Shipping:

1. Where precoated items are to be shipped to the Site, protect coating from damage. Batten coated items to prevent abrasion.
2. Protect shop painted surfaces during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.

B. Storage:

1. Store products in a protected area that is heated or cooled to maintain temperatures within the range recommended by paint manufacturer.
2. Primed surfaces shall not be exposed to weather for more than 2 months before being topcoated, or less time if recommended by coating manufacturer.

1.06 PROJECT CONDITIONS

A. Environmental Requirements:

1. Do not apply paint in temperatures or moisture conditions outside of manufacturer's recommended maximum or minimum allowable.
2. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nationally recognized manufacturers of paints and protective coatings who are regularly engaged in the production of such materials for essentially identical service conditions.

B. Minimum of 5 years' verifiable experience in manufacture of specified product.

C. Each of the following manufacturers is capable of supplying most of the products specified herein:

1. Akzo Nobel (Devoe, International).
2. Carboline.
3. PPG.
4. Sherwin-Williams.
5. Tnemec.

2.02 ABRASIVE MATERIALS

A. Select abrasive type and size to produce surface profile that meets coating manufacturer's recommendations for specific primer and coating system to be applied.

2.03 PAINT MATERIALS

A. General:

1. Manufacturer's highest quality products suitable for intended service.
2. Compatibility: Only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats.
3. Thinners, Cleaners, Driers, and Other Additives: As recommended by coating manufacturer.

B. Products:

Product	Definition
Epoxy Primer—Ferrous Metal	Anticorrosive, converted epoxy primer containing rust-inhibitive pigments
Epoxy Primer—Other	Epoxy primer, high-build, as recommended by coating manufacturer for specific galvanized metal, copper, or nonferrous metal alloy to be coated
Fusion Bonded Coating	100% solids, thermosetting, fusion bonded, dry powder epoxy, suitable for the intended service
High Build Epoxy	Polyamidoamine epoxy, minimum 69% volume solids, capability of 4 to 8 MDFT per coat
NSF Epoxy	Polyamidoamine epoxy, approved for potable water contact and conforming to NSF 61
Polyurethane Enamel	Two-component, aliphatic or acrylic based polyurethane; high gloss finish

2.04 MIXING

A. Multiple-Component Coatings:

1. Prepare using each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed beyond their pot life.
4. Furnish small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by paint manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

B. Colors: Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at Site.

2.05 SHOP FINISHES

A. Shop Blast Cleaning: Reference Paragraph Shop Coating Requirements.

B. Surface Preparation: Provide Engineer minimum 7 days' advance notice to start of shop surface preparation work and coating application work.

C. Shop Coating Requirements:

1. When required by equipment specifications, such equipment shall be primed and finish coated in shop by manufacturer and touched up in field with identical material after installation.
2. Where manufacturer's standard coating is not suitable for intended service condition, Engineer may approve use of a tie-coat to be used between manufacturer's standard coating and specified field finish. In such cases, tie-coat shall be surface tolerant epoxy as recommended by manufacturer of specified field finish coat. Coordinate details of equipment manufacturer's standard coating with field coating manufacturer.

D. Pipe:

1. Steel Pipe:
   a. Surface preparation and application of primer and finish coats shall be performed by pipe manufacturer.
   b. For pipe with epoxy lining, do not place end cap seals until pipe lining material has sufficiently cured.

PART 3 EXECUTION

3.01 GENERAL

A. Provide Engineer minimum 7 days' advance notice to start of field surface preparation work and coating application work.

B. Perform the Work only in presence of Engineer, unless Engineer grants prior approval to perform the Work in Engineer's absence.

C. Schedule inspection of cleaned surfaces and all coats prior to succeeding coat in advance with Engineer.

3.02 EXAMINATION

A. Factory Finished Items:

1. Schedule inspection with Engineer before repairing damaged factory-finished items delivered to Site.
2. Repair abraded or otherwise damaged areas on factory-finished items as recommended by coating manufacturer. Carefully blend repaired areas into original finish. If required to match colors, provide full finish coat in field.

B. Surface Preparation Verification: Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.

3.03 PROTECTION OF ITEMS NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.

B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.

D. Mask openings in motors to prevent paint and other materials from entering.

E. Protect surfaces adjacent to or downwind of Work area from overspray.

3.04 SURFACE PREPARATION

A. Field Abrasive Blasting:

1. Perform blasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed or coated.
2. Refer to coating systems for degree of abrasive blasting required.
3. Where the specified degree of surface preparation differs from manufacturer’s recommendations, the more stringent shall apply.

B. Surface Contamination Testing:

1. A surface contamination analysis test shall be performed every 500 square feet by means of a Chlor Test CSN Salts, “or-equal.”
2. Surfaces with chloride levels exceeding 3 µg/square centimeter for submerged surfaces and 5 µg/centimeter for exposed surfaces shall be treated with a liquid soluble salt remover equivalent to CHLOR*RID (CHLOR*RID International, Chandler, AZ).
3. Follow manufacturer’s recommendations and procedures for the use of this product to remove the surface contamination.

C. Metal Surface Preparation:

1. Where indicated, meet requirements of SSPC Specifications summarized below:
    a. SP 1, Solvent Cleaning: Removal of visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants by cleaning with solvent.
    b. SP 2, Hand Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using nonpower hand tools.
    c. SP 3, Power Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using power-assisted hand tools.
    d. SP 5, White Metal Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter by blast cleaning.
    e. SP 6, Commercial Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 33 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
    f. SP 7, Brush-Off Blast Cleaning: Removal of visible rust, oil, grease, soil, dust, loose mill scale, loose rust, and loose coatings. Tightly adherent mill scale, rust, and coating may remain on surface.
    g. SP 10, Near-White Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 5 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
    h. SP 11, Power Tool Cleaning to Bare Metal: Removal of visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter using power-assisted hand tools capable of producing suitable surface profile. Slight residues of rust and paint may be left in lower portion of pits if original surface is pitted.

i. SP-16, Brush Blasting of Non-Ferrous Metals: A brush-off blast cleaned non-ferrous metal surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, metal oxides (corrosion products), and other foreign matter. Intact, tightly adherent coating is permitted to remain. A coating is considered tightly adherent if it cannot be removed by lifting with a dull putty knife. Bare metal substrates shall have a minimum profile of 19 micrometers (0.75 mil).

2. The words “solvent cleaning,” “hand tool cleaning,” “wire brushing,” and “blast cleaning,” or similar words of equal intent in these Specifications or in paint manufacturer’s specification refer to the applicable SSPC Specification.
3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers’ recommendations for wet blast additives and first coat application shall apply.
4. Ductile Iron Pipe Supplied with Asphaltic Varnish Finish: Remove asphaltic varnish finish prior to performing specified surface preparation.
5. Hand tool clean areas that cannot be cleaned by power tool cleaning.
6. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
7. Welds and Adjacent Areas:
   a. Prepare such that there is:
      1) No undercutting or reverse ridges on weld bead.
      2) No weld spatter on or adjacent to weld or any area to be painted.
      3) No sharp peaks or ridges along weld bead.
   b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
8. Preblast Cleaning Requirements:
   a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
   b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
   c. Clean small isolated areas as above or solvent clean with suitable solvent and clean cloth.

9. Blast Cleaning Requirements:
    a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.
    b. Select type and size of abrasive to produce surface profile that meets coating manufacturer's recommendations for particular primer to be used.
    c. Use only dry blast cleaning methods.
    d. Do not reuse abrasive, except for designed recyclable systems.
    e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.
10. Post-Blast Cleaning and Other Cleaning Requirements:
    a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
    b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.

3.05 SURFACE CLEANING

A. Brush-off Blast Cleaning:

1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC SP 7.
2. Abrasive: Either wet or dry blasting sand, grit, or nutshell.
3. Select various surface preparation parameters, such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.
4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.
5. Engineer will review acceptable trial blast cleaned area and use area as a representative sample of surface preparation.
6. Repair or replace surface damaged by blast cleaning.

B. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods that involve a solvent or cleaning action.
2. Meet requirements of SSPC SP 1.

3.06 APPLICATION

A. General:

1. The intention of these Specifications is for new, interior and exterior metal, and submerged metal surfaces to be painted, whether specifically mentioned or not, except as specified otherwise.
2. Extent of Coating (Immersion): Coatings shall be applied to internal vessel and pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless steel internals, unless otherwise specified.
3. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating until completion of curing cycle.
4. Apply coatings in accordance with these Specifications and paint manufacturers' printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.
5. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
6. Fusion Bonded Coatings Method Application: Electrostatic, fluidized bed, or flocking.
7. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.
8. Keep paint materials sealed when not in use.
9. Where more than one coat is applied within a given system, alternate colors to provide a visual reference showing required number of coats have been applied.

B. Film Thickness and Coverage:

1. Number of Coats:
   a. Minimum required without regard to coating thickness.
   b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.

2. Application Thickness:
   a. Do not exceed coating manufacturer's recommendations.
   b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.
3. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
   a. Perform with properly calibrated instruments.
   b. Recoat and repair as necessary for compliance with specification.
   c. Coats are subject to inspection by Engineer and coating manufacturer's representative.
4. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.
5. Apply additional coats as required to achieve complete hiding of underlying coats. Hiding shall be so complete that additional coats would not increase the hiding.

3.07 PROTECTIVE COATINGS SYSTEMS AND APPLICATION SCHEDULE

A. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from Engineer before starting work in question.

B. System No. 1 Submerged Metal—Potable Water:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 5, White Metal Blast Cleaning	NSF Epoxy	3 coats, 3 MDFTPC

1. Use on the following items or areas:
   a. Metal surfaces new and below a plane 1 foot above the maximum liquid surface; metal surfaces above the maximum liquid surface that are a part of the immersed equipment; surfaces of metallic items, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel that are embedded in concrete; and the following specific surfaces:
      1) Interior lining of steel pipe where specifically required to be epoxy lined.

C. System No. 4 Exposed Metal—Highly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Epoxy Primer—Ferrous Metal	1 coat, 2.5 MDFT
	High Build Epoxy	1 coat, 4 MDFT
	Polyurethane Enamel	1 coat, 3 MDFT

1. Use on the following items or areas:
   a. Exposed metal surfaces, new and existing located inside of vaults or structures. This includes bolts (head and tail), nuts, tie-rod threads, and valves the same color as the waterline.

D. System No. 5 Exposed Metal—Mildly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Epoxy Primer—Ferrous Metal	1 coat, 2.5 MDFT
	Polyurethane Enamel	1 coat, 3 MDFT

1. Use on the following items or areas:
   a. Exposed metal surfaces, new and existing located outside of structures and exposed to weather.

E. System No. 7 Concrete Encased Metal:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 6, Commercial Blast Cleaning	High Build Epoxy	2 coats, 16 MDFT

1. Use on the following items or areas:
   a. Concrete encased surfaces of ferrous metals, including wall pipes, pipe sleeves, and access manholes, not specified to be coated with another system.

F. System No. 18 Concrete Tank Lining—Potable Water:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Concrete Surface Preparation	Epoxy Filler/Surfacer (NSF-approved)	As required to fill voids and level surface
	NSF Epoxy	3 coats, 250 SFPGPC

1. Use on the following items or areas:
   a. For signage on interior submerged concrete surfaces of the reservoirs.

G. System No. 29 Fusion Bonded Coating:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Fusion Bonded Coating 100% Solids Epoxy	1 or 2 coats, 7 MDFT

1. For steel pipe and fittings, meet all requirements of AWWA C213.
2. Use on the following items:
   a. As an alternative external coating for items located inside vaults or structures.

H. System No. 29A Fusion Bonded, Steel Dowel Coating:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Fusion Bonded Coating 100% Solids Epoxy	1 or 2 coats, 7 MDFT

1. Use as indicated in individual product specifications for steel pipe, fittings and appurtenances, and items to meet all requirements of AWWA C213.

3.08 COLORS

A. Provide as selected by Owner or Engineer.

B. Proprietary identification of colors is for identification only. Selected manufacturer may supply matches.

C. Equipment Colors:

1. Paint equipment and piping one color as selected.
2. Paint nonsubmerged portions of equipment the same color as the piping it serves, except as itemized below:
   a. Dangerous Parts of Equipment and Machinery: OSHA Orange.
   b. Fire Protection Equipment and Apparatus: OSHA Red.
   c. Radiation Hazards: OSHA Purple.
   d. Physical hazards in normal operating area and energy lockout devices, including, but not limited to, electrical disconnects for equipment and equipment isolation valves in air and liquid lines under pressure: OSHA Yellow.

3.09 FIELD QUALITY CONTROL

A. Testing Equipment:

1. Provide calibrated electronic type dry film thickness gauge to test coating thickness specified in mils.
2. Provide low-voltage wet sponge electrical holiday detector to test completed coating systems, 20 mils dry film thickness or less, except zinc primer, high-build elastomeric coatings, and galvanizing, for pinholes, holidays, and discontinuities, as manufactured by Tinker and Rasor, San Gabriel, CA, Model M-1.
3. Provide high-voltage spark tester to test completed coating systems in excess of 20 mils dry film thickness. Unit as recommended by coating manufacturer.

B. Testing:

1. Thickness and Continuity Testing:
   a. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2. Check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.
   b. All coatings subject to immersion service shall be holiday tested on 100 percent of the coated surface.
   c. Holiday detect coatings 20 mils thick or less, except zinc primer and galvanizing, with low voltage wet sponge electrical holiday detector in accordance with NACE SP0188.
   d. Holiday detect coatings in excess of 20 mils dry with high voltage spark tester as recommended by coating manufacturer and in accordance with NACE SP0188.
   e. After repaired and recoated areas have dried sufficiently, retest each repaired area. Final tests may also be conducted by Engineer.

C. Inspection: Leave staging and lighting in place until Engineer has inspected surface or coating. Replace staging removed prior to approval by Engineer. Provide additional staging and lighting as requested by Engineer.

D. Unsatisfactory Application:

1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.
2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
3. Repair defects in accordance with written recommendations of coating manufacturer.

E. Damaged Coatings, Pinholes, and Holidays:

1. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
2. Remove rust and contaminants from metal surface. Provide surface cleanliness and profile in accordance with surface preparation requirements for specified paint system.
3. Feather edges and repair in accordance with recommendations of paint manufacturer.
4. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.10 CLEANUP

A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at end of each day.

B. Upon completion of the Work, remove staging, scaffolding, and containers from Site or destroy in a legal manner.

C. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

3.11 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are a part of this Specification.

1. Paint System Data Sheet (PSDS).
2. Paint Product Data Sheet (PPDS).

END OF SECTION

PAINT SYSTEM DATA SHEET (PSDS)

Complete this PSDS for each coating system, include all components of the system (surface preparation, primer, intermediate coats, and finish coats). Include all components of a given coating system on a single PSDS.

Paint System Number (from Spec.):		
Paint System Title (from Spec.):		
Coating Supplier:		
Representative:		
Surface Preparation:		
Paint Material (Generic)	**Product Name/Number (Proprietary)**	**Min. Coats, Coverage**

PAINT PRODUCT DATA SHEET (PPDS)

Product: _____

Complete and attach manufacturer's Technical Data Sheet to this PPDS for each product submitted. Provide manufacturer's recommendations for the following parameters at temperature (F)/relative humidity:

Temperature/RH	50/50	70/30	90/25
Induction Time			
Pot Life			
Shelf Life			
Drying Time			
Curing Time			
Min. Recoat Time			
Max. Recoat Time			

Provide manufacturer's recommendations for the following:

Mixing Ratio: _____

Maximum Permissible Thinning: _____

Ambient Temperature Limitations: min.: _____ max.:_____

Surface Temperature Limitations: min.:_____ max.:_____

Surface Profile Requirements: min.:_____ max.:_____

SECTION 09 97 13.01
PIPELINE TAPE COATING

PART 1 GENERAL

1.01 REQUIREMENTS

A. Provide shop-applied, multi-layer tape coating system for the exterior of buried steel pipelines.

B. Except as described in this section, conform to ANSI/AWWA C214 for straight pipe sections and ANSI/AWWA C209 for fittings and specials.

C. Cathodic Protection: Coordinate as specified in Section 26 42 01, Pipe Bonding and Test Stations.

1.02 REFERENCES

A. The following is a list of standards that may be referenced in this section.

1. American Water Works Association (AWWA):
   a. C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
   b. C210, Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
   c. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
2. ASTM International (ASTM): D1000, Methods of Testing Pressure-Sensitive Adhesive Coated Tapes Used for Electrical Insulation.
3. NACE International (NACE): SP0274, High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation.
4. NSF International (NSF):
   a. 61, Drinking Water System Components - Health Effects.
   b. 372, Drinking Water System Components - Lead Content.
5. Society for Protective Coatings (SSPC) Surface Preparation Standards:
   a. SP-1, Solvent Cleaning Surface Preparation.
   b. SP-2, Hand Tool Cleaning Surface Preparation.
   c. SP-3, Power Tool Cleaning Surface Preparation.
   d. SP-6, Commercial Abrasive Blast Surface Preparation.
   e. SP-5, White Metal Abrasive Blast Surface Preparation.
   f. SP-10, Near White Metal Abrasive Blast Surface Preparation.
   g. SSPC Paint Application Guides: PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.

1.03 DEFINITIONS

A. Manufacturer’s Representative: Employee of manufacturer who is factory trained and knowledgeable in technical aspects of their products and systems.

1.04 SUBMITTALS

A. Action Submittals:

1. Coating Materials List: Tape coating materials indicating manufacturer, products, and thickness.
2. Materials Information: Technical data sheets with technical and performance information indicating compliance with requirements of this section and reference standards.

B. Informational Submittals:

1. Samples of tape materials. Identify each sample with catalog number, size, color, and other information.
2. Shop and Field Applicator’s Quality Control Program: Submit Quality Control Plan in accordance with Section 01 45 16.13, Contractor Quality Control.

1.05 QUALITY ASSURANCE

A. Perform coating work in the presence of Engineer, unless otherwise approved by Owner.

B. Coating Applicator's Experience and Certification: Certified by the coating manufacturer as an approved applicator and having a minimum of 5 years’ experience installing the submitted coating system.

C. Provide a qualified technical representative, employed by the coating manufacturer, in the shop and the field for 1 day, minimum, at the start of coating application. During this visit, the manufacturer’s representative will conduct observations and tests as required to ensure that coating application is in conformance with their recommended methods and conditions.

D. Provide additional visits by the manufacturer’s representative at sufficient intervals during surface preparation and coating application as may be required for product application quality assurance, and to determine compliance with manufacturer’s instructions, and as may be necessary to resolve problems attributable to, or associated with, manufacturer’s products furnished for this Project.

E. Applicator's Quality Control Program:

1. Quality Control Test Frequency: In accordance with coating manufacturer's recommended quality control program parameters and these Specifications.
2. Minimum Test Documentation:
   a. Environmental conditions including, but not limited to, date and time, weather conditions, precipitation, ambient temperature, relative humidity, and dew point.
   b. Steel temperature at time of surface preparation.
   c. Visual observations of prepared surface.
   d. Surface profile of prepared steel using Surface Profile Comparator Reference Disks and 10 power magnifier, Testex Press-O-Film, "or-equal."
   e. Equipment tests, including, but not limited to moisture and oil contamination in compressed air.
   f. Materials stored and used at site including manufacturer, products, expiration date, and batch numbers.
   g. Abrasive Used, including, but not limited to:
      1) Product and gradation (particle size).
      2) Percentage of shot/grit for recycled abrasive.
      3) Tests for cleanliness of recycled abrasive.
   h. Wet film coating thickness.
   i. Dry film coating thickness.
   j. Results of final coating inspection, including holiday and adhesion tests.
   k. Record of type and number of coating repairs.
3. Furnish calibrated inspection devices in good working condition for measurement of environmental conditions, surface profile, film thickness, adhesion and holiday detection.
4. Provide trained technicians to test the coating system and prepare reports.
5. Record quality control test data on approved forms. Maintain forms readily accessible to either the coating manufacturer or Owner's representative.

1.06 OBSERVATION OF WORK

A. Provide written advance notice to Engineer a minimum of 7 days prior to the start of any shop coating work.

B. Make provisions to allow Engineer full access to the Work and documentation regarding coating application.

C. Engineer may elect to observe materials for suitability prior to or during incorporation into the Work, including compliance with proper storage of materials and material expiration dates.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle coated pipe in accordance with reference standards and protect coating from damage.

B. Allow coatings to develop sufficient strength for stability before handling and pipe installation.

C. Lift pipe with web slings of width and type compatible with the coating. Pad coating whenever chain, cable, tongs, forklifts, or other equipment are used to handle pipe.

D. Transport coated pipe square-stacked on padded supports or racks with padding under load ties.

E. Inspect coating for damage upon arrival at the Site. Repair damage if permitted by Engineer; otherwise replace pipe.

F. When stringing pipe along the trench, support pipe on padded blocks or mounds of finely graded material. Do not place coated pipe on rocks or pavement without padding.

PART 2 PRODUCTS

2.01 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 POLYETHYLENE TAPE COATING SYSTEM

A. Tape Coating Suppliers:

1. Factory and Field Tape Coating Systems:
   a. Polyken Tape Technology as manufactured by Seal For Life, Tapes and Coatings Division, Franklin, MA.

b. TapeCoat as manufactured by Chase Corporation, Westwood, MA.

2. Product numbers are listed for first named manufacturer.
3. Supply coating materials from a single manufacturer.

B. Provide straight pipe sections with a four-layer polyethylene tape system, ANSI/AWWA C214 compliant, such as Polyken YGIII:

1. Primer: Liquid adhesive, Polyken 1019 or Polyken 1039.
2. Filler Tape: Extruded butyl rubber compound, Polyken 939.
3. Inner Layer: Corrosion protection tape (20 mils), Polyken 989-20.
4. Middle Layer: Mechanical protection tape (30 mils), Polyken 955-30 Gray.
5. Outer Layer: Mechanical protection tape (30 mils) with ultraviolet light stabilizers for 12-month protection, Polyken 956-30 White.
6. Total System Thickness: 80 mils minimum.

C. Provide fittings and specials with a three-layer polyethylene tape system, ANSI/AWWA C209 Type II compliant:

1. Primer: Liquid adhesive, Polyken 1019 or Polyken 1039.
2. Filler Tape: Extruded butyl rubber compound, Polyken 939.
3. Inner Layer: Corrosion protection tape (50 mils), Polyken 930-50 Black.
4. Outer Layer: Mechanical protection tape (30 mils), Polyken 955 Gray.
5. Total System Thickness: 80 mils, minimum.
6. Supply the coating material by the same manufacturer as the materials for straight pipe.

2.03 EPOXY COATING

A. Two-component epoxy suitable for buried or immersion application, Paint System No. 1 as specified in Section 09 90 00, Painting and Coating.

B. Where epoxy coating will be in contact with potable water, provide product with NSF certification for potable water contact.

2.04 CEMENT MORTAR OVERCOAT

A. Provide cement mortar and reinforcing materials in accordance with ANSI/AWWA C205.

PART 3 EXECUTION

3.01 GENERAL

A. Apply coating materials in accordance with this section, tape manufacturer's product application instructions, and coating manufacturer's field technical support instructions. The requirements of the applicable ANSI/AWWA standard shall apply in the absence of more stringent or more specific requirements of the coating manufacturer.

B. Apply coatings for atmospherically exposed pipe and fittings in accordance with Section 09 90 00, Painting and Coating.

C. Provide coatings for pipe exposed inside vaults and structures in accordance with Section 09 90 00, Painting and Coating.

D. Coat buried coated pipe and fittings passing through a concrete structure wall or floor a minimum of 2 inches beyond the interior wall or floor surface.

3.02 WELD PREPARATION

A. Grind welds higher than 1/32 inch above pipe surface to less than 1/32 inch above the surface.

B. Grind welds on pipe ends used with sleeve-type couplings flush with pipe surface within 18 inches of pipe ends.

C. Use care when grinding welds to avoid gouging adjacent steel. Damage to pipe wall will be cause for rejection of the pipe.

3.03 SURFACE PREPARATION

A. Remove burrs, sharp edges, and weld spatter prior to abrasive blasting.

B. The words "solvent cleaning", "hand tool cleaning," "wire brushing," and "blast cleaning," or similar words of equal intent, in these Specifications or in paint manufacturer's specifications refer to the applicable SSPC Specifications.

C. Detergent clean surfaces in accordance with SSPC-SP1 prior to abrasive blasting.

D. Immediately before primer application, perform abrasive blasting using media suitable to produce a surface in conformance with SSPC-SP6 or better. Provide a surface profile between 1-1/2 mils and 3 mils or as recommended in writing by coating manufacturer.

E. Comply with applicable federal, state, and local air pollution and environmental control regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, and coating application.

F. Do not perform abrasive blast cleaning when relative humidity exceeds 85 percent, or when surface temperature is less than 5 degrees F above the ambient air dew point.

G. Do not apply coatings when:

1. Surface and ambient temperatures are outside the maximum and minimum temperatures recommended by the paint manufacturer or these Specifications.
2. In dust- or smoke-laden atmosphere, blowing dust or debris, damp or humid weather, or under conditions that could cause icing on the metal surface.

H. When weather conditions or Project requirements dictate, provide and operate heaters and dehumidification equipment to allow pipe surfaces to be abrasive blasted and coated as specified and in accordance with the manufacturer's written coating application recommendations.

3.04 PIPE END PREPARATION

A. Welded Pipe Joints: Hold back tape coating at pipe ends 6 inches or as required for the specific joint. Holdbacks shall be uniform and parallel to the pipe ends. Protect exposed steel surfaces with storage primer applied immediately after taping and before flash rusting of the surface. Use storage primer compatible with joint coating materials and welding operations.

3.05 APPLICATION OF TAPE

A. Store and apply primer in accordance with manufacturer's requirements.

1. Use spray method and drum agitator. Provide uniform prime coat without skips, misses, runs or drips.
2. Allow primer to dry to the condition recommended by manufacturer prior to application of tape. Keep primed surface clean and free of contamination.

B. Maintain pipe temperature within a range of 45 degrees F to 100 degrees F during tape system application.

C. Maintain tape rolls at manufacturer's recommended temperature prior to application. Maintain inner layer tape at a minimum roll body temperature of 70 degrees F during application. Maintain middle and outer layer tapes at a minimum roll body temperature of 90 degrees F during application. Maintain tape temperature within 20 degrees F of pipe surface temperature during application.

D. Maintain tape tension at a value that produces a tape width reduction equal to 1.5 percent to 2.0 percent of the tape width during application as recommended by tape manufacturer. Continuously maintain width reduction simultaneously with required tape temperature.

E. At the point of tape application, press tape onto pipe with a pressure roller that maintains a constant pressure. Use sufficient pressure to fully bond tape to pipe.

F. Use filler tape at lap joints, weld step-downs, and other discontinuities to prevent bridging of tape coating.

3.06 INSPECTION AND TESTING

A. Electrically holiday test each section of pipe after application of the inner wrap. Repair holidays before application of additional tape layers. Retest the repaired area for holidays. Test holidays in middle and outerwrap layers in accordance with tape manufacturer's instructions.

B. Inspect and test finished tape coating system for complete bonding and absence of bubbles, voids, gaps, and wrinkles.

C. Perform adhesion tests in accordance with ANSI/AWWA C214 or ANSI/AWWA C209, as applicable to the coating being tested.

D. Remove and replace coatings at all defects found. Repair coatings damaged by adhesion testing.

3.07 SHOP REPAIRS

A. Repair detected holidays (defects) before application of additional tape layers. Repair the holiday area by priming and applying a patch of repair tape. Cover the repair tape a minimum of 4 inches in each direction from damaged area. Retest the repaired area for holidays. Test holidays in middle and outerwrap layers in accordance with the tape manufacturer's directions.

3.08 TAPE APPLICATION TO FITTINGS AND SPECIALS

A. Prepare and prime surfaces as specified in this section.

B. Use filler tape to fill voids and prevent bridging of tape coating at discontinuities.

C. Apply inner tape layer using manual tension control device. Cover all surfaces as specified in ANSI/AWWA C209.

D. Visually inspect tape application and perform holiday testing; repair all defects found.

E. Apply outer tape layer using manual tension control and roller as required to completely cover and seal inner tape layer without gaps or wrinkles.

F. Complete final visual inspection for complete coverage and bond of outer layer to inner layer.

3.09 EPOXY COATING FOR PIPE IN VAULTS AND STRUCTURES

A. Provide the epoxy coating for pipe located below grade in vaults, in structures, and where shown on Drawings. Prepare surfaces, apply coating, test and repair in accordance with Section 09 90 00, Painting and Coating.

B. Where tape-coated pipe enters vaults or structures, overlap epoxy-coated pipe with pipeline tape, 2 inches minimum.

3.10 FIELD QUALITY CONTROL

A. Immediately before lowering coated pipe into the trench, provide a visual and field electrical holiday inspection of the tape coating on the pipe.

B. Electrical Coating Inspection:

1. Furnish one portable high-voltage detector for each pipe laying crew.
2. Electrically test field-applied pipe coatings and pipe coating repairs with portable high-voltage holiday detector. Provide equipment and conduct testing in accordance with NACE Standard SP0274 and the coating manufacturer’s written directions for type and thickness of coating being tested.
3. Perform holiday testing at the voltage determined by the following formula:
    a. Testing Voltage equals 1,250 √T where T equals average coating thickness in mils.

4. Provide detector with minimum and maximum voltage setting, inspection speed, and holiday detector electrode type (wire brush or electrically conductive silicone or coil spring) as recommended by coating manufacturer for the coating type and thickness being tested. Maintain holiday test equipment in good working condition in accordance with detector manufacturer's recommendations.
5. Adjust the holiday detector during testing to the correct voltage setting and operate in accordance with holiday detector manufacturer's recommendations. Recheck voltage setting at start of each day and a minimum of two times during the day.
6. Provide an acceptable ground and a low electrical resistance between the holiday detector and the pipeline. Make only direct connections to uncoated areas or to the pipe ends at the pipe joint cut back areas.
7. Mark location of detected holidays for repair. Retest after repair.

3.11 FIELD REPAIR OF TAPE COATING

A. Conduct field repairs including pipe surface preparation, primer application, and tape coating in a continuous operation. Store, handle, and apply products used for field coating in accordance with ANSI/AWWA C209 and AWWA C214 and the tape manufacturer's instructions.

B. Thoroughly mix primer prior to application and keep container sealed when not in use. Do not dilute primer. Apply primer above 50 degrees F.

C. Preheat pipe when required to achieve and maintain the temperature range specified by the coating manufacturer.

D. Temporarily enclose work areas as required to provide protection from moisture, dust, and conditions that prevent proper coating repairs.

E. Repair areas where damage or holidays are present. Repair coating shall have the same number of layers and thickness as the damaged factory coating. Minor repairs may use field primer and 4-inch or 6-inch-wide repair tape.

F. Remove damaged coating layers. Holiday test the inner wrap prior to repair of outer wrap. Provide one extra layer of repair tape to areas where coating damage to the base metal is present.

G. Solvent Wipe: Solvent clean (SSPC-SP-1) areas of oil and grease contamination with an approved solvent. Use solvent recommended by coating manufacturer.

H. Thoroughly mix primer and apply to clean surface. Keep primed area free of contamination and allow to dry to the condition recommended by the manufacturer before application of repair tape.

I. Remove release liner just prior to application of the tape to the primed pipe surface. Dispose of the release liner properly and not in the pipe trench. Protect the adhesive surface of the tape from moisture and contamination.

J. Apply repair tape of the same color as the shop applied tape to primed area and press firmly into place. Extend repair tape a minimum of 4 inches in each direction onto undamaged coating. If damaged area is wider than the repair tape width, provide a minimum of 4-inch coverage in each direction by lapping the first tape layer with additional repair tape layers. Lap each layer over the first layer, 1-inch minimum, as required to provide the minimum 4-inch coverage. Start the first layer at the bottom side of the pipe so that additional layers overlap top portion of first layer.

K. If the damaged area is over 6 inches in size, apply the outer layer in a straight wrap around entire pipe circumference. Overlap straight wrap ends a minimum of 6 inches and point downward.

L. Tape repairs that do not adhere tightly to the factory coating and present a smooth appearance will be rejected. Apply, test and repair field coating to a condition equal to the original factory-coated system.

END OF SECTION

SECTION 09 97 13.02
PIPELINE JOINT COATING

PART 1 GENERAL

1.01 REQUIREMENT

A. Except as described in this section, coat field installed joints in dielectric coated pipe in accordance with ANSI/AWWA C209 for tape coating or ANSI/AWWA C216 for heat-shrinkable sleeves.

B. For pipe with cement-mortar overcoat, coat field-installed joints with cement mortar in accordance with ANSI/AWWA C2015, except as described in this section.

C. Coat irregular surfaces, such as flanges and couplings, in accordance with ANSI/AWWA C217, except as described in this section.

D. Cathodic Protection: Coordinate as specified in Section 26 42 01, Pipe Bonding and Test Stations.

1.02 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. ANSI/AWWA:
   a. C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. (100 mm) and Larger - Shop Applied.
   b. C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
   c. C216, Heat-Shrinkable, Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
   d. C217, Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines.
2. NACE International (NACE): SP0274, High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation.
3. Society for Protective Coatings (SSPC) Surface Preparation Standards:
   a. SP-1, Solvent Cleaning Surface Preparation.
   b. SP-2, Hand Tool Cleaning Surface Preparation.
   c. SP-3, Power Tool Cleaning Surface Preparation.
   d. SP-5, White Metal Abrasive Blast Surface Preparation.
   e. SP-6, Commercial Abrasive Blast Surface Preparation.
   f. SP-10, Near White Metal Abrasive Blast Surface Preparation.
   g. SP-11, Power-Tool Cleaning to Bare Metal.

1.03 DEFINITIONS

A. Manufacturer's Representative: Employee of manufacturer who is factory trained and knowledgeable in technical aspects of their products and systems.

1.04 SUBMITTALS

A. Action Submittals:

1. Materials List: Joint coating materials indicating manufacturer, product numbers, and thickness.
2. Materials Information: Technical data sheets with technical and performance information indicating compliance with requirements of this section and reference standards.

B. Informational Submittals:

1. Samples of coating materials. Identify each sample with catalog number, size, color, and other information.
2. Recommended procedures for installation quality assurance.
3. Letter from manufacturer of shop-applied holding primer applied to joints stating that shop primer at pipe holdbacks is compatible with the joint coating.

1.05 QUALITY ASSURANCE

A. Provide a qualified technical representative, employed by the coating manufacturer, in the field for 1 day, minimum, at the start of coating application. Conduct manufacturer's representative observations and tests as required to confirm that coating application is in conformance with manufacturer's recommended methods and conditions.

B. Provide additional visits by manufacturer's representative at sufficient intervals during surface preparation and coating application as required for product application quality assurance, and to confirm compliance with manufacturer's instructions, and as necessary to resolve problems attributable to, or associated with, manufacturer's products furnished for this Project.

C. Furnish calibrated inspection devices in good working condition for measurement of environmental conditions, surface profile, film thickness, adhesion, and holiday detection. Use trained technicians to test the coating system and prepare reports.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store all coating products including primer, filler, tape, heat shrinkable sleeves, and wax tape in accordance with manufacturer's written instructions.

PART 2 PRODUCTS

2.01 COATING SYSTEMS

A. Heat Shrinkable Sleeves: In accordance with ANSI/AWWA C216, Type II and this section.

1. Canusa-CPS; ShawCor:
   a. Primer: As recommended by sleeve manufacturer.
   b. Mastic: Aqua-Shield RG Filler.
   c. Heat Shrink Sleeve: Aqua-Shield AQW.
   d. Minimum Total Thickness: 80 mils; 100 mils after recovery.
2. Seal For Life; Berry Plastics (Covalence):
   a. Primer: As recommended by sleeve manufacturer.
   b. Mastic: Covalence 939-125 filler.
   c. Heat Shrink Sleeve: WaterWrap PCI.
   d. Minimum Total Thickness: 80 mils; 100 mils after recovery.
3. Size heat shrink sleeves to provide minimum overlap as shown on Drawings, or as required by heat shrink sleeve manufacturer, whichever is greater.

B. Cement-Mortar Overcoat:

1. Cement: Meeting the requirements of ANSI/AWWA C205.
2. Bands: Polyethylene foam-lined fabric with steel strapping of sufficient strength to hold fresh mortar, resist rodding of the mortar, and allow excess water to escape.
   a. 100 percent closed cell.
   b. Chemically inert, insoluble in water, resistant to acids, alkalis and solvents.
   c. Manufacturer and Product: Dow Chemical Company; Ethafoam 222.
   d. Fabric Backing:
      1) Cut and sewn into strips wide enough to overlap shop-coated areas by 4 inches on either side.
      2) Provide slots in the strips for steel strapping on outer edges.

PART 3 EXECUTION

3.01 PREPARATION

A. Prepare joint area for coating after completion of pipe jointing.

B. Trim off any damaged or curled coating resulting from welding or preheating.

C. Remove weld spatter. Grind sharp edges and corners to remove potential stress points in joint coating.

D. Prepare steel surfaces with intact primer as recommended by joint coating manufacturer. Verify compatibility of shop primer applied to holdback area with joint coating manufacturer.

E. Abrasive blast rusted steel surfaces to a minimum of SSPC SP-6. As an alternative, and as approved by Engineer or Owner, surfaces may be prepared using power tool cleaning in accordance with SSPC SP-11.

3.02 JOINT COATINGS

A. Tape Coating Application:

1. In accordance with ANSI/AWWA C209 and as described below:
    a. Apply primer to prepared steel surfaces and allow to dry as recommended by coating manufacturer.
    b. Apply filler tape at lap joints, step-downs, and other discontinuities to fully support tape and prevent voids, gaps, or bridging.
    c. Apply inner tape layer using manual tension control device. Cover all surfaces, overlapping the tape as specified in ANSI/AWWA C209.
    d. Visually inspect tape application and perform holiday testing in accordance with NACE SP0274; repair all defects found.
    e. Apply outer tape layer using manual tension control and roller as required to completely cover and seal inner tape layer without gaps or wrinkles.
2. Perform final visual inspection for complete bond of outer layer to inner layer.

B. Heat Shrinkable Coating Application:

1. In accordance with ANSI/AWWA C216 and as described below:
   a. Preheat steel to maintain temperature in the required range during installation of joint coating. Apply primer to prepared steel surfaces and allow to dry as recommended by coating manufacturer.
   b. Apply filler tape to lap joints, step-downs, and other discontinuities to fully support tape and prevent voids, gaps, or bridging. For welded lap joints, apply filler on the weld and adjacent spigot.
   c. Loosely fit heat-shrink sleeve over joint, using spot attachments and closure strips as specified by manufacturer.
   d. Heat sleeve center portion on the spigot side of the weld to conform sleeve to the spigot and weld. Use gloved hand or light roller pressure to press sleeve into the base of weld as sleeve shrinks. Allow sleeve center portion to fully conform to the weld around the pipe circumference before shrinking sleeve outer edges.
   e. Work outward from center toward edges to shrink sleeve onto pipe. Press sleeve outer edges onto shop coating.
   f. Visually inspect installed sleeve to confirm that it is free of holes, and conforms to surfaces along pipe joint contour. Confirm that adhesive is visible along sleeve edges.
2. After joint has cooled to ambient temperature, examine sleeve and conduct holiday testing in accordance with NACE SP0274. Confirm that sleeves tightly conform to pipe and without holidays, voids or gaps.

C. Cement Mortar: Mix mortar and install in accordance with ANSI/ AWWA C205.

3.03 IRREGULAR SURFACES

A. Field coat irregular surfaces of buried field assembled flanges and couplings, including fasteners and restraining rods, with wax tape in accordance with ANSI/AWWA C217. Use manufacturer’s recommended filler to eliminate voids and provide a smooth surface for tape. Provide plastic sheet outer wrap to prevent mechanical damage to tape during backfill.

B. Perform visual inspection to verify proper application with no voids or discontinuities.

END OF SECTION

SECTION 26 05 01
ELECTRICAL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway Transportation Officials (AASHTO).
2. ASTM International (ASTM):
   a. A240/A240M, Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
   b. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
   c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
   d. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
3. Electronic Industries Association (EIA/TIA): 569, Commercial Building Standard for Telecommunications Pathways and Spaces.
4. Federal Specifications (FS):
   a. W-C-596, Connector, Electrical, Power, General Specification for.
   b. W-S-896, Switch, Toggle (Toggle and Lock), Flush Mounted (General Specification).
5. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
   b. PC62.41.1, Draft Guide on the Surge Environment in Low-Voltage (1,000 V and less) AC Power Circuits.
   c. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
   d. 114, IEEE Standard Test Procedure for Single-Phase Induction Motors.
6. International Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
7. National Electrical Contractor’s Association, Inc. (NECA): 1, Standard Practices for Good Workmanship in Electrical Contracting.

8. National Electrical Manufacturers Association (NEMA):
    a. C80.1, Rigid Steel Conduit-Zinc Coated.
    b. C80.3, Electrical Metallic Tubing-Zinc Coated.
    c. C80.6, Intermediate Metal Conduit-Zinc Coated (IMC).
    d. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
    e. CC1, Electrical Power Connectors for Substations.
    f. ICS 1, Industrial Control and Systems: General Requirements.
    g. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC.
    h. ICS 2.3, Industrial Control and Systems: Instructions for the Handling, Installation, Operation and Maintenance of Motor Control Centers.
    i. MG 1, Motors and Generators.
    j. PB 1, Panelboards.
    k. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
    l. ST 20, Dry Type Transformers for General Applications.
    m. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
    n. TC 3, PVC Fittings for Use with Rigid PVC Conduit and Tubing.
    o. WC 57, Instrumentation Cables and Thermocouple Wire.
    p. WC 70, Standard for Non-Shielded Power Cables Rated 2,000 V or Less for the Distribution of Electrical Energy.
    q. WC 71, Standard for Non-Shielded Cables Rated 2001-5,000 Volts for use in the Distribution of Electrical Energy.
    r. WC 74, 5-46 KV Shielded Power Cable for use in the Transmission and Distribution of Electric Energy.
    s. WD 1, General Color Requirements for Wiring Devices.
9. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
10. UL:
    a. 1, Flexible Metal Conduit.
    b. 6, Electrical Rigid Metal Conduit—Steel.
    c. 13, Power-Limited Circuit Cables.
    d. 44, Thermoset Insulated Wires and Cables.
    e. 62, Flexible Cord and Fixture Wire.
    f. 67, Panelboards.
    g. 98, Enclosed and Dead-Front Switches.
    h. 198C, High Interrupting Capacity Fuses, Current Limiting Types.
    i. 198E, Class R Fuses.
    j. 360, Liquid-Tight Flexible Steel Conduit.
    k. 486A, Wire Connectors and Soldering Lugs for Use with Copper Conductors.
    l. 486C, Splicing Wire Connectors.

m. 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
n. 508, Industrial Control Equipment.
o. 510, Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
p. 514B, Fittings for Cable and Conduit.
q. 651, Schedule 40 and 80 PVC Conduit.
r. 674, Electric Motors And Generators for use in Division 1 Hazardous (Classified) Locations.
s. 797, Electrical Metallic Tubing.
t. 854, Service-Entrance Cables.
u. 870, Wireways, Auxiliary Gutters, and Associated Fittings.
v. 943, Ground-Fault Circuit Interrupters.
w. 1059, Terminal Blocks.
x. 1242, Intermediate Metal Conduit.
y. 1277, Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
z. 1449, Surge Suppressors.
aa. 1561, Dry-Type General Purpose and Power Transformers.
bb. 2111, Overheating Protection for Motors.

1.02 DEFINITIONS

A. AHJ: Authority Having Jurisdiction.

B. MCOV: Maximum Allowable Continuous Operating Voltage.

C. MOV: Metal Oxide Varistor.

D. SASD: Silicon Avalanche Suppressor Diode.

E. SVR: Surge Voltage Rating.

F. SPD: Surge Protective Device.

1.03 SUBMITTALS

A. Action Submittals:

1. Service entrance and metering equipment.
2. Boxes and device plates.
3. Junction and pullboxes.
4. Precast handholes.
5. Wiring devices.
6. Panelboards and mini-power centers.
7. Circuit breakers and switches.

8. Motor-rated switches.
9. Control devices, terminal blocks, and relays.
10. Transformers.
11. Support and framing channels.
12. Nameplates and nameplate schedule.
13. SPD equipment.
14. Conduit, fittings, and accessories.
15. Wireways.
16. Conductors, cable, and accessories.
17. Grounding materials.
18. Luminaires.
19. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
3. Factory test reports.
4. Field test reports.
5. Signed permits indicating Work is acceptable to regulatory authorities having jurisdiction.
6. Operation and Maintenance Data:
   a. As specified in Section 01 78 23, Operation and Maintenance Data.
   b. Provide for all equipment, as well as each device having features that can require adjustment, configuration, or maintenance.
   c. Minimum information shall include manufacturer’s preprinted instruction manual, one copy of the approved submittal information for the item, tabulation of any settings, and copies of any test reports.

1.04 APPROVAL BY AUTHORITY HAVING JURISDICTION

A. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.

B. Materials and equipment manufactured within the scope of standards published by UL, shall conform to those standards and shall have an applied UL listing mark or label.

1.05 QUALIFICATIONS

A. PVC-Coated, Rigid Steel Conduit Installer: Must be certified by conduit manufacturer as having received minimum 2 hours of training on installation procedures.

B. Testing Firm Qualifications: Professionally independent of manufacturers, suppliers, and installers, or electrical equipment and systems being tested.

1.06 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

1. Fuses, 0 Volt to 600 Volts: Six of each type and each current rating installed.

PART 2 PRODUCTS

2.01 GENERAL

A. Products shall comply with all applicable provisions of NFPA 70.

B. Like Items of Equipment: End products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer’s service.

C. Equipment and Devices Installed Outdoors or in Unheated Enclosures: Capable of continuous operation within ambient temperature range of minus 40 degrees F to 110 degrees F.

D. Hazardous Areas: Products shall be acceptable to the regulatory authority having jurisdiction for the class, division, and group of hazardous area indicated.

E. Equipment Finish:

1. Manufacturer’s standard finish color, except where specific color is indicated.
2. If manufacturer has no standard color, finish equipment in accordance with Section 09 90 00, Painting and Coating.

2.02 OUTLET AND DEVICE BOXES

A. Sheet Steel: One-piece drawn type, zinc- or cadmium-plated.

B. Cast Metal:

1. Box: Cast ferrous metal.
2. Cover: Gasketed, weatherproof, and cast ferrous metal with stainless steel screws.
3. Hubs: Threaded.
4. Lugs: Cast Mounting.
5. Manufacturers and Products, Nonhazardous Locations:
   a. Crouse-Hinds; Type FS or FD.
   b. Appleton; Type FS or FD.
6. Manufacturers and Products, Hazardous Locations:
   a. Crouse-Hinds; Type GUA or EAJ.
   b. Appleton; Type GR.

C. PVC-Coated Cast Metal:

1. Type: One-piece.
2. Material: Malleable iron, cast ferrous metal, or cast aluminum.
3. Coating:
   a. All Exterior Surfaces; 40 mils PVC.
   b. All Interior Surfaces, 2 mils urethane.
4. Manufacturers:
   a. Robroy Industries.
   b. Ocal.

2.03 JUNCTION AND PULL BOXES

A. Outlet Boxes Used as Junction or Pull Box: As specified under Article Outlet and Device Boxes.

B. Conduit Bodies Used as Junction Boxes: As specified under Article Conduit and Fittings.

C. Large Cast Metal Box:

1. NEMA 250, Type 4.
2. Box: Cast ferrous metal, electrogalvanized finished, with drilled and tapped conduit entrances and exterior mounting lugs.
3. Cover: Hinged with clamps.
4. Gasket: Neoprene.
5. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.

6. Manufacturers and Products, Surface Mounted Nonhinged Type:
   a. Crouse-Hinds; Series W.
   b. O-Z/Gedney; Series Y.
7. Manufacturer and Product, Surface Mounted, Hinged Type: O-Z/Gedney; Series YW.
8. Manufacturers and Products, Recessed Type:
   a. Crouse-Hinds; Type WJBF.
   b. O-Z/Gedney; Series YR.

D. Large Stainless Steel Box:

1. NEMA 250, Type 4X.
2. Box: 14-gauge, ASTM A240, Type 304 stainless steel, with white enamel painted interior mounting panel.
3. Cover: Hinged with clamps.
4. Hardware and Machine Screws: ASTM A167, Type 304 stainless steel.
5. Manufacturers:
   a. Hoffman Engineering Co.
   b. Robroy Industries.

E. Concrete Box, Nontraffic Areas:

1. Box: Reinforced, cast concrete with extension.
2. Cover: Steel diamond plate with locking bolts.
3. Cover Marking: ELECTRICAL, TELEPHONE, or as shown.
4. Size: 10 inch by 17 inch (minimum).
5. Manufacturer and Product: Utility Vault Co.; Series 36-1017PB, with cover DP.

2.04 PRECAST HANDHOLES

A. Construction: Precast concrete.

B. Loading: AASHTO H-10 or H-20, as noted below, in accordance with ASTM C857.

C. Drainage:

1. Slope floors toward drain points leaving no pockets or other nondraining areas.
2. Provide drainage outlet at low point of floor.

D. Raceway Entrances: Provide knockout panels on all four sides.

E. Handhole Frames and Covers:

1. Material: Steel, hot-dipped galvanized.
2. Cover Type: Solid, bolt-on or hinged, of checkered design, as noted below.
3. Cover Loading: As noted below.
4. Cover Designation: Lettering minimum 2 inches in height, as shown.

F. Hardware: Steel, hot-dip galvanized.

G. Furnish knockout for ground rod in each handhole.

H. Manufacturer and Models: Utility Vault Company.

1. Small: H-10 incidental traffic loading; Model 3030-B with 3030-DP cover.
2. Large: H-20 off-street traffic loading; Model 444-LA with 44-332P cover.

2.05 WIRING DEVICES

A. Switches:

1. NEMA WD 1 and FS W-S-896.
2. Industrial grade, totally enclosed, ac type, with quiet tumbler switches and screw terminals.
3. Capable of controlling 100 percent tungsten filament and fluorescent lamp loads.
4. Rating: 20 amps, 120/277 volts.
5. Color: Brown.
6. Automatic grounding clip and integral grounding terminal on mounting strap.
7. Manufacturers and Products:
   a. Leviton; 1221 Series.
   b. Bryant; 4901 Series.
   c. Hubbell; 1221 Series.

B. Receptacle, Single and Duplex:

1. NEMA WD 1 and FS W-C-596.
2. Specification grade, two-pole, three-wire grounding type with screw type wire terminals suitable for No. 10 AWG.
3. High strength, thermoplastic base color.
4. Color: Brown.
5. Contact Arrangement: Contact to be made on two sides of each inserted blade without detent.

6. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps.
7. One-piece mounting strap with integral ground contact (rivetless construction).
8. Manufacturers and Products:
   a. Arrow Hart; 5362 Series.
   b. Leviton; 5362 Series.
   c. Bryant; 5362 Series.
   d. Hubbell; 5362 Series.

C. Receptacle, Ground Fault Circuit Interrupter:

1. Duplex, listed Class A to UL Standard 943, tripping at 5 mA.
2. Color: Brown.
3. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps.
4. Size: For 2-inch by 4-inch outlet boxes.
5. Standard Model: NEMA WD 1, with No. 12 AWG copper USE/RHH/RHW-XLPE insulated pigtails and provisions for testing.
6. Feed-Through Model: NEMA WD 1, with No. 12 AWG copper USE/RHH/RHW-XLPE insulated pigtails and provisions for testing.
7. Impact resistant nylon face.
8. Manufacturers:
   a. Bryant.
   b. Hubbell.
   c. Leviton.

2.06 DEVICE PLATES

A. General: Sectional type plates not permitted.

B. Metal:

1. Material: Specification grade, one-piece, 0.040-inch nominal thickness stainless steel.
2. Finish: ASTM A167, Type 302/304, satin.
3. Mounting Screw: Oval-head, finish matched to plate.

C. Cast Metal:

1. Material: Malleable ferrous metal.
2. Screw: Oval-head stainless steel.

D. Weatherproof:

1. For Receptacles, Damp Locations:
   a. Gasketed, cast-aluminum, with individual cap over each receptacle opening.

b. Mounting Screw and Cap Spring: Stainless steel.
c. Manufacturers and Products:
1) Crouse-Hinds; Type WLRD-1.
2) Appleton; Type FSK-WRD.

2. For Receptacles, Wet Locations:
a. Impact-resistant, nonmetallic, single-gang, horizontal-mounting, providing, while in-use, NEMA 3R rating.
b. Stainless steel mounting and hinge hardware.
c. Lockable, paintable.
d. Color: Gray.
e. Manufacturers:
1) Carlon.
2) Leviton.

3. For Switches:
a. Gasketed, cast-metal or cast-aluminum, incorporating external operator for internal switch.
b. Mounting Screw: Stainless steel.
c. Manufacturers and Products:
1) Crouse-Hinds; DS-181 or DS-185.
2) Appleton; FSK-1VTS or FSK-1VS.

2.07 LIGHTING AND POWER DISTRIBUTION PANELBOARD

A. NEMA PB 1, NFPA 70, and UL 67.

B. Panelboards and Circuit Breakers: Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

C. Short-Circuit Current Equipment Rating: Fully rated; series connected unacceptable.

D. Rating: Applicable to a system with available short-circuit current of 10,000 amperes or the indicated value amperes rms symmetrical at 208Y/120 volts or 120/240 volts and 14,000 amperes or the indicated value amperes rms symmetrical at 480Y/277 volts.

E. Cabinet:

1. NEMA 250, Type 3R.
2. Material: Code-gauge, hot-dip galvanized sheet steel with reinforced steel frame.
3. Wiring Gutter: Minimum 4-inch square; both sides, top and bottom.
4. Front: Fastened with adjustable clamps.
a. Trim Size: As required by mounting.
b. Finish: Manufacturer’s standard.

5. Interior:
   a. Factory assembled; complete with circuit breakers.
   b. Spaces: Cover openings with easily removable metal cover.
6. Door Hinges: Concealed.
7. Locking Device:
   a. Flush type.
   b. Doors Over 30 Inches in Height: Multipoint.
   c. Identical keylocks, with two milled keys each lock.
8. Circuit Directory: Metal frame with transparent plastic face and enclosed card on interior of door.

F. Bus Bar:

1. Material: Copper full sized throughout length.
2. Neutral: Insulated, rated same as phase bus bars with at least one terminal screw for each branch circuit.
3. Ground: Copper, installed on panelboard frame, bonded to box with at least one terminal screw for each circuit.
4. Lugs and Connection Points:
   a. Suitable for either copper or aluminum conductors.
   b. Solderless main lugs for main, neutral, and ground bus bars.
   c. Subfeed or through-feed lugs as shown.

G. Circuit Breakers:

1. UL 489.
2. Thermal-magnetic, quick-make, quick-break, molded case, of indicating type showing ON/OFF and TRIPPED positions of operating handle.
3. Type: Bolt-on circuit breakers in all panelboards.
4. Multipole circuit breakers designed to automatically open all poles when an overload occurs on one pole.
5. Do not use tandem or dual circuit breakers in normal single-pole spaces.
6. Ground Fault Circuit Interrupter (GFCI): UL Class A GFCI, 5 mA trip, and 10,000 amps interrupting capacity circuit breakers.

H. Manufacturers:

1. Eaton.
2. GE/ABB.
3. Square D/Schneider Electric.

2.08 MINI-POWER CENTER (MPC)

A. General: Transformer, primary and secondary main circuit breakers, and secondary panelboard section enclosed in NEMA 250, Type 3R enclosure.

B. Transformer:

1. Type: Dry, self-cooled, encapsulated.
2. Insulation: Manufacturer's standard, with UL 1561 temperature rise.
3. Copper core and coil: encapsulated units; impregnated with thermosetting varnish.
4. Full capacity, 2-1/2 percent voltage taps, two above and two below normal voltage.
5. Primary Voltage: 480 Volts, single-phase.
6. Secondary Voltage: 240/120 Volts, single-phase, three-wire.

C. Panelboard: UL 489, fully-rated.

1. Type: Thermal-magnetic, quick-make, quick-break, indicating, with noninterchangeable molded case circuit breakers.
2. Number and Breaker Ampere Ratings: Refer to Panelboard Schedule.

D. Manufacturers:

1. Eaton.
2. GE/ABB.
3. Square D/Schneider Electric.

2.09 CIRCUIT BREAKER, INDIVIDUAL, 0 VOLTS TO 600 VOLTS

A. UL 489 listed for use at location of installation.

B. Minimum Interrupt Rating: As shown.

C. Thermal-magnetic, quick-make, quick-break, indicating type showing ON/OFF and TRIPPED indicating positions of operating handle.

D. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

E. Locking: Provisions for padlocking handle.

F. Enclosure: As specified under Execution.

G. Interlock: Enclosure and switch shall interlock to prevent opening cover with breaker in the ON position.

H. Manufacturers:

1. Eaton.
2. GE/ABB.
3. Square D/Schneider Electric.

2.10 FUSED SWITCH, INDIVIDUAL, 0 VOLTS TO 600 VOLTS

A. UL 98 listed for use and location of installation.

B. NEMA KS 1 and UL 98 Listed for application to system with available short-circuit current of 10,000 amps rms symmetrical.

C. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.

D. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

E. Fuse mountings shall reject Class H fuses and accept only current-limiting fuses specified.

F. Enclosure: As specified under Execution.

G. Interlock: Enclosure and switch to prevent opening cover with switch in ON position.

H. Manufacturers:

1. Eaton.
2. GE/ABB.
3. Square D/Schneider Electric.

2.11 NONFUSED SWITCH, INDIVIDUAL, 0 VOLTS TO 600 VOLTS

A. NEMA KS 1.

B. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.

C. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

D. Enclosure: As specified under Execution.

E. Interlock: Enclosure and switch to prevent opening cover with switch in the ON position.

F. Manufacturers:

1. Eaton.
2. GE/ABB.
3. Square D/Schneider Electric.

2.12 SWITCH, MOTOR-RATED

A. Type: Two-pole or three-pole, manual motor starting/disconnect switch without overload protection.

B. Enclosure/Mounting and Rating:

1. General Purpose:
   a. Totally enclosed snap-action switch. Quick-make, slow-break design with silver alloy contacts. Listed UL 508.
   b. General Purpose Rating: 30 amperes, 600V ac.
   c. Minimum Motor Ratings:
      1) 2 hp for 120V ac, single-phase, two-pole.
      2) 3 hp for 240V ac, single-phase, two-pole.
      3) 15 hp for 480V ac, three-phase, three-pole.
   d. Screw-type terminals.
2. Explosion-proof:
   a. Provide enclosed manual motor starter-type. Three-pole nonreversing contactor.
   b. Minimum Motor Rating: 10 hp, 480V ac, three-phase, three-pole.
   c. Enclosure: NEMA 250, Type 7.
   d. Provide lockable external handle operator.

C. Manufacturers:

1. General Purpose:
   a. Bryant.
   b. Hubbell.
2. Explosion-proof: Eaton, Type B101.

2.13 FUSE, 0 VOLTS TO 600 VOLTS

A. Current-limiting, with 200,000 ampere rms interrupting rating.

B. Provide to fit mountings specified with switches and features to reject Class H fuses.

C. Motor and Transformer Circuits, 0 Volts to 600 Volts:

1. Amperage: 0 Volts to 600 Volts.
2. UL 198E, Class RK-1, dual element, with time delay.
3. Manufacturers and Products:
   a. Bussmann; Type LPS-RK.
   b. Littelfuse, Inc.; Type LLS-RK.

D. Motor and Transformer Circuits, 0 Volt to 250 Volt:

1. Amperage: 0 Volt to 600 Volt.
2. UL 198E, Class RK-1, dual element, with time delay.
3. Manufacturers and Products:
   a. Bussmann; Type LPN-RK.
   b. Littelfuse, Inc.; Type LLN-RK.

E. Feeder and Service Circuits, 0 Volt to 600 Volt:

1. Amperage: 0 Volt to 600 Volt.
2. UL 198E, Class RK-1, dual element, with time delay.
3. Manufacturers and Products:
   a. Bussmann; Type LPS-RK.
   b. Littelfuse, Inc.; Type LLS-RK.

F. Feeder and Service Circuits, 0 Volt to 250 Volt:

1. Amperage: 0 Volt to 600 Volt.
2. UL 198E, Class RK-1, dual element, with time delay.
3. Manufacturers and Products:
   a. Bussmann; Type LPN-RK.
   b. Littelfuse, Inc.; Type LLN-RK.

G. Feeder and Service Circuits, 0 Volt to 600 Volt:

1. Amperage: 601 Volt to 6,000 Volt.
2. UL 198C, Class L, double O-rings and silver links.
3. Manufacturers and Products:
   a. Bussmann; Type KRP-C.
   b. Littelfuse, Inc.; Type KLPC.

2.14 PUSHBUTTONS, INDICATING LIGHTS, AND SELECTOR SWITCHES

A. Type: Heavy-duty, oiltight. Provide contact arrangements, colors, inscriptions, and functions as shown.

B. Contact Rating: NEMA ICS 2, Type A600.

C. Unless otherwise shown, provide the following features:

1. Selector Switch Operating Lever: Standard.
2. Indicating Lights: Push-to-test, transformer-type.
3. Pushbutton Color:
   a. ON or START: Black.
   b. OFF or STOP: Red.

4. Pushbuttons and selector switches lockable in OFF position where indicated.

D. Legend Plate:

1. Material: Aluminum.
2. Engraving: Indicating specific function, or as shown.
3. Letter Height: 7/64-inch.

E. Manufacturers and Products:

1. GE/ABB; Type CR 104P.
2. Square D/Schneider Electric; Type T.
3. Eaton; Type 10250T.

2.15 TERMINAL BLOCKS

A. Type: UL 1059. Compression screw clamp, with current bar providing direct contact with wire and yoke, with individual rail mounted terminals. Marking system shall permit use of preprinted or field-marked tags.

B. Yokes and Clamping Screws: Zinc-plated, hardened steel.

C. Rating: 600V ac.

D. Manufacturers:

1. Weidmuller, Inc.
2. Ideal.

2.16 MAGNETIC CONTROL RELAYS

A. NEMA ICS 2, Class A600 (600 volts, 10 amperes continuous, 7,200VA make, 720VA break), machine tool type with field convertible contacts.

B. Manufacturer and Model:

1. Eaton; Type M-600.
2. General Electric; Type CR120B.

2.17 DRY TYPE POWER TRANSFORMERS (0-VOLT TO 600-VOLT PRIMARY)

A. Type: Self-cooled, two-winding.

B. UL 1561 and NEMA ST 20.

C. Insulation Class, Temperature Rise, and Impedance: Manufacturer’s standard.

D. Copper core and Coil:

1. 30 kVA or Less: Encapsulated.
2. 37.5 kVA and Larger: Varnish impregnated.

E. Enclosure:

1. 30 kVA or Less: NEMA 250, Type 3R, nonventilated.
2. 37.5 kVA and Larger: NEMA 250, Type 2, ventilated.

F. Voltage Taps: Full capacity, 2-1/2 percent, two above and two below normal voltage rating.

G. Sound Level: Not to exceed NEMA ST 20 levels.

H. Vibration isolators to minimize and isolate sound transmission.

I. Manufacturers:

1. General Electric.
2. Eaton.
3. Square D.

2.18 SUPPORT AND FRAMING CHANNELS

A. Carbon Steel Framing Channel:

1. Material: Rolled, mild strip steel, 12 gauge, ASTM A1011/A1011M, Grade 33.
2. Finish: Hot-dip galvanized after fabrication.

B. Stainless Steel Framing Channel: Rolled, ASTM A167, Type 316 stainless steel, 12 gauge.

C. Manufacturers:

1. B-Line Systems, Inc.
2. Unistrut Corp.

2.19 NAMEPLATES

A. Material: Laminated plastic.

B. Attachment: Adhesive.

C. Color: Black, engraved to a white core, or as shown.

D. Engraving:

1. Devices and Equipment: Name or tag shown, or as required.
2. Panelboards:
   a. Designation.
   b. Service voltage.
   c. Phases.
3. Minimum Requirement: Label metering and power distribution equipment, local control panels, junction boxes, motor controls, and transformers.

E. Letter Height:

1. Pushbuttons, Selector Switches, and Other Devices: 1/8-inch.
2. Equipment and Panelboards: 1/4-inch.

2.20 PRESSURE GAUGE

A. General:

1. Function: Local pressure indication.
2. Type: Bourdon tube element.

B. Performance:

1. Scale Range: 0 psig to 300 psig.
2. Accuracy: Plus or minus 0.50 percent of full scale.

C. Features:

1. Dial: 4-1/2-inch diameter.
2. Pointer Vibration Reduction: Required, unless otherwise noted. Use the following method.
   a. Liquid filled gauge front, unless otherwise noted.
      1) Glycerin fill, unless otherwise noted.
3. Case Material: Black thermoplastic, unless otherwise noted.
4. Materials of Wetted Parts (including element, socket/process connection, throttling device (if specified) and secondary components): Stainless steel, unless otherwise noted.
5. Pointer: Adjustable by removing ring and window.
6. Window: Glass or acrylic, unless otherwise noted.
7. Threaded reinforced polypropylene front ring.
8. Case Type: Solid front with blow-out back.

D. Process Connection:

1. Mounting: Lower stem, unless otherwise noted.
2. Size: 1/2-inch MNPT, unless otherwise noted.

E. Manufacturers and Products:

1. Ashcroft; Duragauge Model 1259/Model, 1279/Model, 1279 PLUS.
2. Ametek U.S. Gauge; Solfrunt Model 19XX/1981Advantatge.
3. WIKA, Type 2XX.34.

2.21 PRESSURE TRANSMITTER

A. General:

1. Function: Measure pressure and transmit signal proportional to pressure.
2. Type:
   a. Electronic variable capacitance or silicon strain gauge.
   b. Two-wire transmitter; “smart electronics.”
3. Parts: Transmitter and accessories.

B. Performance:

1. Range: 0 psig to 300 psig.
2. Accuracy: Plus or minus 0.075 percent of span, unless otherwise noted.
3. Ambient Operating Temperature: Minus 40 degrees F to plus 175 degrees F, with integral meter.
4. Process Operating Temperature: Minus 40 degrees F to plus 250 degrees F.
5. Humidity: 0 percent to 100 percent relative humidity.

C. Features:

1. Type: Gauge pressure, unless otherwise noted.
2. Adjustable damping.
3. LCD indicator, unless otherwise noted. Display in either percent or engineering units, field configurable.
4. Wetted Metallic Parts: Type 316 stainless steel, unless otherwise noted.
   a. Includes drain/vent valves; process flanges and adapters, and process isolating diaphragm.
5. Wetted O Rings: Glass filled TFE, graphite filled PTFE, or Viton, unless otherwise noted.
6. Bolts and Nuts (if required): Type 316 stainless steel, unless otherwise noted.

D. Process Connections:

1. Line Size: 1/2-inch.
2. Connection Type: FNPT.

E. Signal Interface:

1. 4 mA dc to 20 mA dc output with digital signal based on HART protocol, unless otherwise noted below.
   a. Nominal Maximum Loop Resistance with External 24V dc. Power Supply: 550 ohms.

F. Enclosure:

1. Type: NEMA 4X.
2. Materials: Coated aluminum, unless otherwise noted.
3. Mounting bracket, unless otherwise noted.
   a. Bracket and Accessories: Stainless steel; suitable for mounting transmitter to panel or 2-inch pipe.

G. Manufacturer and Product:

1. Gauge Pressure Units: Rosemount; Model 3051TG2A2B21AS5General:

2.22 FLOW ELEMENT AND TRANSMITTER, ELECTROMAGNETIC

A. General:

1. Function: Measure, indicate, and transmit the flow of a conductive process liquid in a full pipe.
2. Type: Electromagnetic flowmeter, with operation based on Faraday’s Law, utilizing the pulsed dc type coil excitation principle with high impedance electrodes.
3. Parts: Flow element, transmitter, interconnecting cables, and mounting hardware.

B. Service:

1. Stream Fluid: As indicated by the Owner.

C. Operating Temperature:

1. Element:
   a. Ambient: Minus 5 degrees F to 140 degrees F, typical, unless otherwise noted.
   b. Process: Minus 5 degrees F to 140 degrees F, typical, unless otherwise noted.

2. Transmitter:
    a. Ambient: Minus 5 degrees F to 140 degrees F, typical, unless otherwise noted.
    b. Storage: 15 degrees F to 120 degrees F, typical, unless otherwise noted.

D. Performance:

1. Flow Range: As provided by the Owner.
2. Accuracy: Plus or minus 0.5 percent of rate for all flows resulting from pipe velocities of 2 feet to 30 feet per second.
3. Turndown Ratio: Minimum of 10 to 1 when flow velocity at minimum flow is at least 1 foot per second.
4. Meter must measure flow in both directions.

E. Features:

1. Zero stability feature to eliminate the need to stop flow to check zero alignment.
2. No obstructions to flow.
3. Very low pressure loss, as identified by the Owner.
4. The meter should be capable of reading flow in both directions.

F. Process Connection:

1. Meter Size (diameter inches): As per Mechanical Drawings.
2. Connection Type: 150 pound ANSI raised-face flanges; AWWA C207, Table 2 Class D; or wafer style depending on meter size, unless otherwise noted.
3. Flange Material: Carbon steel, unless otherwise noted.

G. Power (Transmitter): 120V ac, 60-Hz, unless otherwise noted.

H. Element:

1. Meter Tube Material: Type 304 or Type 316 stainless steel, unless otherwise noted.
2. Liner Material: Teflon, unless otherwise noted.
3. Liner Protectors: Covers (or grounding rings) on each end to protect liner during shipment.
4. Electrode Type: Flush or bullet nose as recommended by the manufacturer for the noted stream fluid.
5. Electrode Material: Type 316 stainless steel or Hastelloy C, unless otherwise noted.

6. Grounding Ring:
    a. Required, unless otherwise noted.
    b. Quantity: Two, unless otherwise noted.
    c. Material: Type 316 stainless steel, unless otherwise noted.
7. Enclosure: NEMA 6P, minimum, unless otherwise noted.
8. Submergence: Continuous (up to 10 feet depth), NEMA 6P/IP68.

I. Transmitter:

1. Mounting: Surface (wall), unless otherwise noted.
2. Display: Required, unless otherwise noted. Digital LCD display, indicating flow rate and total.
3. Parameter Adjustments: By keypad or nonintrusive means.
4. Enclosure: NEMA 6P, minimum, unless otherwise noted.
5. Empty Pipe Detection: Drives display and outputs to zero when empty pipe detected.

J. Signal Interface (at Transmitter):

1. Output; Input: Modbus RS485.
2. Discrete Outputs: If noted.
    a. Two discrete outputs, typical, rated for up to 30 volts, typical.
    b. Programmable as noted for the following typical parameters: Totalizer pulse, high/low flow rates, percent of range, empty pipe zero, fault conditions, forward/reverse, etc.
3. Discrete Input: If noted.
    a. Contact closure, configured as noted for the following typical parameters: reset totalizer, change range, hold output constant, drive output to zero, and low flow cutoff, etc.

K. Cables:

1. Types: As recommended by manufacturer.
2. Lengths: As required to accommodate device locations. See Drawings.

L. Built in Diagnostic System:

1. Features:
    a. Field programmable electronics.
    b. Self-diagnostics with troubleshooting codes.
    c. Ability to program electronics with full scale flow, engineering units, meter size, zero flow cutoff, desired signal damping, totalizer unit digit value, etc.
    d. Initial flow tube calibration and subsequent calibration checks.

M. Factory Calibration:

1. Calibrated in an ISO 9001 and NIST certified factory.
2. Factory flow calibration system must be certified by volume or weight certified calibration devices.
3. Factory flow calibration system shall be able to maintain calibration flow rate for at least 5 minutes for repeatability point checks.

N. Manufacturer and Product:

1. Endress & Hauser; Style ProMag W 400.
2. Rosemount; 8750W Magnetic Flowmeter System.
3. “Or-equal.”

2.23 INTRUSION SWITCH, MAGNETIC:

A. General:

1. Function: Industrial wide gap surface mount magnetic contact switch for intrusion detection on access hatches, featuring high strength extruded aluminum housing.
2. Type: The contact shall be a hermetically sealed reed switch with matching actuating magnet. Mounting holes on two-inch centers. Contact and magnets in brushed anodized aluminum tube housing.

B. Manufacturer and Product:

1. GE Security/Interlogix; 2507AH.
2. “Or-equal.”

2.24 SURGE PROTECTIVE DEVICE (SPD) EQUIPMENT

A. General:

1. Units shall be suitable for the service voltage and configuration (phases and wires) shown.
2. Protection Modes:
   a. Normal, differential, and common.
   b. Bipolar or bi-directional.
3. Ratings: Short-circuit current rating shall equal or exceed that of protected distribution equipment. Surge Voltage Rating (SVR) shall not exceed those specified under UL 1449 for the associated nominal system voltage. Maximum Allowable Continuous Operating Voltage (MCOV) shall be at least 115 percent of the nominal system voltage.
4. Unit shall be UL-listed.

5. Provide status indicators for unit ON-LINE and unit operation NORMAL.
6. Provide common alarm contact output.
7. Provide fusible disconnect switch (integral with SPD unit, where available) where not shown connected via branch circuit device of protected distribution equipment.
8. Minimum Enclosure Rating: NEMA 250, Type 2. Provide Type 4/4X for outdoor or wet locations.

B. Type 1 SPD:

1. Requirements: High surge current device designed for location/exposure Category C3, per IEEE C62.41. Provide surge current rating per phase as shown. Unit shall utilize symmetrically balanced Metal Oxide Varistor (MOV) technology.
2. Manufacturer and Product: Transtector; Model Aegis SP.

C. Type 2 SPD:

1. Requirements: Designed for critical loads at service equipment (Category C3/B3) or distribution panelboard (Category C2/B3) locations. Unit shall utilize voltage-matched Silicon Avalanche Suppressor Diode (SASD) technology. Unit shall utilize modular, plug-in suppressor design.
2. Manufacturer and Product: Transtector; Model Apex III (nonservice entrance distribution panelboard) or Apex IV (service equipment).

D. Type 3 SPD:

1. Requirements: Designed for noncritical loads at distribution panelboards with location/exposure Category C3. Unit shall utilize symmetrically balanced Metal Oxide Varistor (MOV) technology. Unit shall utilize modular, plug-in suppressor design.
2. Manufacturer and Product: Transtector; Model SPD.

2.25 CONDUIT AND FITTINGS

A. Rigid Galvanized Steel Conduit (RGS):

1. Meet requirements of NEMA C80.1 and UL 6.
2. Material: Hot-dip galvanized, with chromated protective layer.

B. Electrical Metallic Tubing (EMT):

1. Meet requirements of NEMA C80.3 and UL 797.
2. Material: Hot-dip galvanized, with chromated and lacquered protective layer.

C. PVC Schedule 40 Conduit:

1. Meet requirements of NEMA TC 2 and UL 651.
2. UL listed for concrete encasement, underground direct burial, concealed, or direct sunlight exposure, and 90 degrees C insulated conductors.

D. Flexible Metal, Liquid-Tight Conduit:

1. UL 360 listed for 105 degrees C insulated conductors.
2. Material: Galvanized steel, with an extruded PVC jacket.

E. Fittings:

1. Provide bushings, grounding bushings, conduit hubs, conduit bodies, couplings, unions, conduit sealing fittings, drain seals, drain/breather fittings, expansion fittings, and cable sealing fittings, as applicable.
2. Rigid Galvanized Steel and Intermediate Metal Conduit:
   a. Meet requirements of UL 514B.
   b. Type: Threaded, galvanized.
3. Electrical Metallic Tubing:
   a. Meet requirements of UL 514B.
   b. Type: Steel body and locknuts with steel or malleable iron compression nuts. Setscrew and drive-on fittings not permitted.
   c. Electro zinc-plated inside and out.
   d. Raintight.
4. PVC Conduit:
   a. Meet requirements of NEMA TC 3.
   b. Type: PVC, slip-on.
5. Flexible Metal, Liquid-Tight Conduit:
   a. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
   b. Insulated throat and sealing O-rings.

2.26 METAL WIREWAYS

A. Meet requirements of UL 870.

B. Type: Steel-enclosed, with removable, hinged cover.

C. Rating: Outdoor raintight.

D. Finish: Gray, baked enamel.

E. Manufacturers:

1. Copper B-Line.
2. Hoffman.

2.27 CONDUIT ACCESSORIES

A. Duct Bank Spacers:

1. Type: Nonmetallic, interlocking, for multiple conduit sizes.
2. Suitable for all types of conduit.
3. Manufacturers:
   a. Underground Device, Inc.
   b. Carlon.

B. Identification Devices:

1. Raceway Tags:
   a. Material: Permanent, nonferrous metal.
   b. Shape: Round.
   c. Raceway Designation: Pressure stamped, embossed, or engraved.
   d. Tags relying on adhesives or taped-on markers not permitted.
2. Warning Tape:
   a. Material: Polyethylene, 4-mil gauge with detectable strip.
   b. Color: Red.
   c. Width: Minimum 3 inches.
   d. Designation: Warning on tape that electric circuit is located below tape.
   e. Identifying Letters: Minimum 1-inch high permanent black lettering imprinted continuously over entire length.

C. Raceway Band:

1. Slip-on Type:
   a. Provide heat-shrinkable, black, medium-wall polyolefin tubing with factory-applied adhesive/sealant. Select product size based upon raceway outside diameter.
   b. Manufacturer and Product: 3M; Type IMCSN, medium wall cable sleeve.

2. Wrap-around Type:
    a. Provide 4-inch width, 20-mil thickness, nonprinted black PVC corrosion protection tape with primer.
    b. Manufacturer and Product: 3M; Type Scotchrap 51 with Scotchrap Pipe Primer.

2.28 CONDUCTORS AND CABLES

A. Conductors 600 Volts and Below:

1. Conform to applicable requirements of NEMA WC 71, WC 72, and WC 74.
2. Conductor Type:
    a. 120-Volt and 277-Volt Lighting, No. 10 AWG and Smaller: Solid copper.
    b. 120-Volt Receptacle Circuits, No. 10 AWG and Smaller: Solid copper.
    c. All Other Circuits: Stranded copper.
3. Insulation: Type THHN/THWN.
4. Direct Burial and Aerial Conductors and Cables:
    a. Type USE/RHH/RHW insulation, UL 854 listed or Type RHW-2/USE-2.
    b. Conform to physical and minimum thickness requirements of NEMA WC 70.
5. Flexible Cords and Cables:
    a. Type SOOW with ethylene propylene rubber insulation in accordance with UL 62.
    b. Conform to physical and minimum thickness requirements of NEMA WC 70.
6. Grounding Conductors: As specified in Article Grounding.

B. 600-Volt Rated Cable:

1. General:
    a. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 20,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.
    b. Permanently and legibly marked with manufacturer’s name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
    c. Suitable for installation in open air, in cable trays, or conduit.
    d. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.

e. Overall Outer Jacket: PVC, flame-retardant, sunlight and oil resistant.

2. Type 20, 16 AWG, Twisted, Shielded Pair Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57.
   a. Outer Jacket: 35 mil nominal.
   b. Individual Pair Shield: 1.35 mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
   c. Dimension: 0.26 inch nominal OD.
   d. Conductors:
      1) Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
      2) 20 AWG, seven-strand tinned copper drain wire.
      3) Insulation: 15 mil PVC.
      4) Color Code: Pair conductors black and white.
   e. Manufacturers:
      1) Okonite Co.
      2) Alpha Wire Corp.

C. Accessories:

1. Tape:
   a. General Purpose, Flame Retardant: 7 mils, vinyl plastic, Scotch Brand 33, rated for 90 degrees C minimum, meeting requirements of UL 510.
   b. Flame Retardant, Cold and Weather Resistant: 8.5 mils, vinyl plastic, Scotch Brand 88.
2. Identification Devices:
   a. Sleeve-type, permanent, PVC, yellow or white, with legible machine-printed black markings.
   b. Manufacturer and Products: Raychem; Type D-SCE or ZH-SCE.
3. Connectors and Terminations:
   a. Nylon, Self-Insulated Crimp Connectors:
      1) Manufacturers and Products:
         a) Thomas & Betts; Sta-Kon.
         b) Burndy; Insulug.
         c) ILSCO.
4. Self-Insulated, Freespring Wire Connector (Wire Nuts):
   a. Plated steel, square wire springs.
   b. UL Standard 486C.
   c. Manufacturers and Products:
      1) Thomas & Betts.
      2) Ideal; Twister.

5. Cable Lugs:
   a. In accordance with NEMA CC 1.
   b. Rated 600 volts of same material as conductor metal.
   c. Uninsulated Crimp Connectors and Terminators:
      1) Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
      2) Manufacturers and Products:
         a) Thomas & Betts; Color-Keyed.
         b) Burndy; Hydent.
         c) ILSCO.
   d. Uninsulated, Bolted, Two-Way Connectors and Terminators:
      1) Manufacturers and Products:
         a) Thomas & Betts; Locktite.
         b) Burndy; Quiklug.
         c) ILSCO.
6. Cable Ties:
   a. Nylon, adjustable, self-locking, and reusable.
   b. Manufacturer and Product: Thomas & Betts; TY-RAP.
7. Heat Shrinkable Insulation:
   a. Thermally stabilized, crosslinked polyolefin.
   b. Manufacturer and Product: Thomas & Betts; SHRINK-KON.

D. Type 30, Unshielded Twisted Pair (UTP) Telephone and Data Cable, 300V:

1. Category 6 UTP, UL listed, and third party verified to comply with TIA/EIA 568-C Category 6 requirements.
2. Suitable for high speed network applications including gigabit ethernet and video. Cable shall be interoperable with other standards compliant products and shall be backward compatible with Category 5 and Category 5e.
3. Provide four each individually twisted pair, 23 AWG conductors, with FEP insulation and blue PVC jacket.
4. NFPA 70 Plenum (CMP) rated; comply with flammability plenum requirements of NFPA 70 and NFPA 262.
5. Cable shall withstand a bend radius of 1-inch minimum at a temperature of minus 20 degrees C maximum without jacket or insulation cracking.
6. Manufacturer and Product: Belden; 7852A.

2.29 FIBER OPTIC CABLE

A. 50/125-micron and 62.5/125-micron, graded-index for use in backbone and horizontal distribution subsystems, meets or exceeds the requirements of TIA 568-C.3, including the following specifications:

1. Maximum Mean Fiber Loss:
   a. 3.5 dB per km at 850 nm.
   b. 1.5 dB per km at 1,300 nm.
2. Minimum OFL Bandwidth:
   a. OM2-500 MHz•km minimum at 850 nm; TIA 492AAAB.
   b. 500 MHz•km minimum at 1,300 nm.
3. Distance Capacity per IEEE 802.3:
   a. 100Mbit Ethernet:
      1) OM2: 300m at 850 nm and 2000m at 1,310 nm.
   b. 1 Gbit Ethernet:
      1) OM2: 600m at 850 nm and 600 at 1310 nm.
   c. 10 Gbit Ethernet—10km at 850 nm and 40km at 1310 nm:
      1) OM2: 82m at 850 nm and 600 at 300 nm.

2.30 ETHERNET FIBER TO COPPER TRANSCEIVERS

A. Function: Convert half/full-duplex fiber optic Ethernet signal to copper Ethernet signal and vice versa.

B. Speed: Auto-negotiating 10/100/1000.

C. Features:

1. Support fiber optic type specified.
2. Fiber Optic Connectors: LC connectors preferred unless otherwise required for SC and ST ancillary devices.
3. Copper Connector: RJ45 unshielded.
4. Power:
   a. Powered by signal.
   b. 120V ac or 24V dc power source.
5. Mounting: Suitable for permanent mounting.
6. Fiber Signal Distance: 100 feet minimum.

D. Manufacturers:

1. Moxa; IMC Series Media Converters.
2. Black Box; LIC/LGC Series Industrial Media Converters.
3. OmniTron; Flexpoint Series Media Converters.
4. N-Tron; MC Series Industrial Media Converters.

2.31 FIBER CENTERS

A. Function: Provides secure place to terminate fiber optic cables.

B. Features:

1. Compartments: Two; one for fiber optic cable, one for jumpers to individual equipment.
2. Coil Former: Former to wind slack cable around, provides controlled long radius bends.
3. Connectors: Minimum 24 LC connectors for entry and exit unless otherwise required for SC and STA ancillary devices.
4. Size: Maximum 450 mm by 300 mm by 100 mm.
5. Construction: 1.5-mm steel with corrosion proof finish.
6. Mountings: Suitable for permanent attachment as shown, or provide separate mountings that do not obscure covers and doors.
7. Doors: Separate doors for cable and jumper terminations.

C. Manufacturers:

1. Ortronics.
2. AT&T.
3. Siecor.

2.32 HOUSINGS

A. Termination Housing:

1. Rack mountable connector housing.
2. Mountable in ECA 310-E compatible 465-mm or 592-mm rack.
3. Available in several sizes, including 1U, 2U, 3U, and 4U.
   One ECA rack space or panel height (denoted as U) is defined as being 44.45 mm in height.
4. In accordance with design requirements of TIA 568-C.3 and polymer compounds flammability requirements of UL 94.
5. Manufactured using 16-gauge aluminum or equivalent for structural integrity.
6. Finished with wrinkled black powder coat for durability.
7. Provide black installation fasteners.

2.33 GROUNDING

A. Ground Rods: Provide copper with minimum diameter of 5/8-inch, and length of 10 feet.

B. Ground Conductors:

1. Equipment: Stranded copper with green, Type THHN/THWN insulation.
2. Direct Buried: Bare stranded copper.

C. Connectors:

1. Exothermic Weld Type:
   a. Outdoor Weld: Suitable for exposure to elements or direct burial.
   b. Indoor Weld: Use low-smoke, low-emission process.
   c. Manufacturers:
      1) Erico Products, Inc.; Cadweld and Cadweld Exolon.
      2) Thermoweld.
2. Compression Type:
   a. Compress-deforming type; wrought copper extrusion material.
   b. Single indentation for conductors 6 AWG and smaller.
   c. Double indentation with extended barrel for conductors 4 AWG and larger.
   d. Single barrels prefilled with oxide-inhibiting and antiseizing compound.
   e. Manufacturers:
      1) Burndy Corp.
      2) Thomas and Betts Co.
      3) ILSCO.
3. Mechanical Type:
   a. Split-bolt, saddle, or cone screw type; copper alloy material.
   b. Manufacturers:
      1) Burndy Corp.
      2) Thomas and Betts Co.

2.34 LUMINAIRES AND ACCESSORIES

A. Specific requirements relating to fixture type, lamp type, and mounting hardware are provided on Drawings.

PART 3 EXECUTION

3.01 GENERAL

A. Install materials and equipment in accordance with manufacturer’s instructions and recommendations.

B. Work shall comply with all applicable provisions of NECA 1.

C. Install materials and equipment in hazardous areas in a manner acceptable to regulatory authority having jurisdiction for the class, division, and group of hazardous areas shown.

D. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.

3.02 PROTECTION FOLLOWING INSTALLATION

A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation.

B. Cap conduit runs during construction with manufactured seals.

C. Close openings in boxes or equipment during construction.

D. Energize space heaters furnished with equipment.

3.03 SERVICE ENTRANCE EQUIPMENT AND METERING

A. Unless otherwise specified or shown, schedule and coordinate work of serving utility as required to provide electric service to the Work.

3.04 OUTLET AND DEVICE BOXES

A. Install suitable for conditions encountered at each outlet or device in wiring or raceway system, sized to meet NFPA 70 requirements.

B. Size:

1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.
    a. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.
2. Ceiling Outlet: Minimum 4-inch octagonal sheet steel device box, unless otherwise required for installed fixture.
3. Switch and Receptacle: Minimum 2-inch by 4-inch sheet steel device box.

C. Locations:

1. Drawing locations are approximate.
2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by Engineer.
3. Light Switch: Install on lock side of doors.

D. Mounting Height:

1. General:
   a. Dimensions given to centerline of box.
   b. Where specified heights do not suit building construction or finish, mount as directed by Engineer.
2. Switches: 48 inches above floor.
3. Thermostat: 54 inches above floor.
4. Receptacles:
   a. Industrial Areas, Workshops: 48 inches above floor unless noted otherwise.
   b. Outdoor, All Areas: 24 inches above finished grade unless noted otherwise.

E. Install plumb and level.

F. Flush Mounted:

1. Install with concealed conduit.
2. Install proper type extension rings or plaster covers to make edges of boxes flush with finished surface.

G. Support boxes independently of conduit by attachment to building structure or structural member.

H. Box Type (Steel Raceway System):

1. Outdoor Locations: Cast metal.
2. Indoor Dry Locations:
   a. Exposed Rigid Conduit or IMC: Cast metal.
3. Indoor Wet Locations:
   a. Exposed Raceways: Cast metal.
   b. Concealed Raceways: Cast metal.
4. Cast-in-Place Concrete Slabs: Sheet steel.

I. Box Type, Corrosive Locations (PVC-Coated rigid Galvanized Steel Raceway System): PVC-coated cast metal with matching cover.

3.05 JUNCTION AND PULL BOXES

A. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.

B. Install pull boxes where necessary in raceway system to facilitate conductor installation.

C. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.

D. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.

E. Use conduit bodies as junction and pull boxes where no splices are required and their use is allowed by applicable codes.

F. Installed boxes shall be accessible.

G. Do not install on finished surfaces.

H. Install plumb and level.

I. Support boxes independently of conduit by attachment to building structure or structural member.

J. At or Belowgrade:

1. Install boxes for belowgrade conduit flush with finished grade in locations outside of paved areas, roadways, or walkways.
2. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.
3. Obtain Engineer's written acceptance prior to installation in paved areas, roadways, or walkways.
4. Use boxes and covers suitable to support anticipated weights.

K. Flush Mounted:

1. Install with concealed conduit.
2. Holes in surrounding surface shall be no larger than required to receive box.
3. Make edges of boxes flush with final surface.

L. Mounting Hardware:

1. Noncorrosive Indoor Dry Areas: Galvanized.
2. Outdoor or Noncorrosive Indoor Wet Areas: Stainless steel.
3. Corrosive Areas: Stainless steel.

M. Location/Type:

1. Indoor and Outdoor, Wet: NEMA 250, Type 4.
2. Indoor and Outdoor, Wet and Corrosive: NEMA 250, Type 4X, stainless steel.
3. Indoor and Outdoor, Wet, Dust, or Oil: NEMA 250, Type 13.

4. Underground Conduit: Concrete.
5. Corrosive: NEMA 250, Type 4X, stainless steel.
6. Outdoor, Where Indicated Weatherproof (WP): NEMA 250, Type 3R.
7. Industrial Use in Areas Not Otherwise Classified: NEMA 250, Type 12, unless otherwise shown.

N. Install Drain/breather fittings in NEMA 250, Type 4 and Type 4X enclosures.

3.06 PRECAST HANDHOLES

A. Excavate, shore, brace, backfill, and final grade in accordance with Section 31 23 16, Excavation, and Section 31 23 23.15, Trench Backfill.

B. Do not install until final raceway grading has been determined.

C. Install such that raceways enter at nearly right angles and as near as possible to one end of wall, unless otherwise shown.

3.07 WIRING DEVICES

A. Switches:

1. Mounting Height: See Article Outlet and Device Boxes.
2. Install with switch operation in vertical position.
3. Install single-pole, two-way switches such that toggle is in up position when switch is on.

B. Receptacles:

1. Install with grounding slot up, except where horizontal mounting is shown, in which case install with neutral slot up.
2. Ground receptacles to boxes with grounding wire only.
3. Weatherproof Receptacles:
   a. Install in cast metal box.
   b. Install such that hinge for protective cover is above receptacle opening.
4. Ground Fault Interrupter: Install feed-through model at locations where ground fault protection is specified for “downstream” conventional receptacles.
5. Special-Purpose Receptacles: Install in accordance with manufacturer’s instructions.

3.08 DEVICE PLATES

A. Securely fasten to wiring device; ensure a tight fit to box.

B. Flush Mounted: Install with all four edges in continuous contact with finished wall surfaces without use of mats or similar materials. Plaster fillings will not be acceptable.

C. Surface Mounted: Plate shall not extend beyond sides of box, unless plates have no sharp corners or edges.

D. Install with alignment tolerance to box of 1/16-inch.

E. Engrave with designated titles.

F. Types (Unless Otherwise Shown):

1. Outdoor: Weatherproof.
2. Indoor:
   a. Flush Mounted Boxes: Metal.
   b. Surface Mounted, Metal Boxes: Cast.

3.09 PANELBOARDS AND MINI-POWER CENTERS

A. Install securely, plumb, in-line and square with walls.

B. Install top of cabinet 6 feet above floor, unless otherwise shown.

C. Provide typewritten circuit directory for each panelboard.

D. Cabinet Location/Type:

1. Indoor Dry: NEMA 250, Type 1.
2. Wet or Outdoor: NEMA 250, Type3R, Outdoor.
3. Industrial Use in Areas Not Otherwise Classified: NEMA 250, Type 12, unless otherwise shown.

3.10 CIRCUIT BREAKERS AND SWITCHES

A. Location and Enclosure Type:

1. Wet or Outdoor: NEMA 250, Type 4.
2. Corrosive: NEMA 250, Type 4X.
3. Wet and Corrosive: NEMA 250, Type 4X.
4. Indoor Dry, Industrial Use: NEMA 250, Type 12.
5. Where Denoted WP: NEMA 250, Type 3R.

3.11 SWITCH, MOTOR RATED

A. Install with switch operation in vertical position such that toggle is in up position when ON.

B. Install within sight of motor when used as a disconnect switch.

C. Mounting Height: See Article Outlet and Device Boxes.

D. Enclosure Type:

1. General Purpose: See Articles Outlet and Device Boxes and Device Plates.
2. Explosion-proof: See product specification.

3.12 TERMINAL BLOCKS

A. Install for termination of control circuits entering or leaving equipment and local control panels.

3.13 DRY TYPE POWER TRANSFORMERS (0-VOLT TO 600-VOLT PRIMARY)

A. Load external vibration isolator such that no direct transformer unit metal is in direct contact with mounting surface.

B. Provide moisture-proof flexible conduit for electrical connections.

C. Connect voltage taps to achieve (approximately) rated output voltage under normal plant load conditions.

D. Provide wall brackets where required.

3.14 SUPPORT AND FRAMING CHANNELS

A. Install where required for mounting and supporting electrical equipment and raceway systems.

B. Channel Type:

1. Interior, Wet or Dry Noncorrosive Locations: Carbon steel.
2. Interior, Wet or Dry Corrosive Locations: Type 316 stainless steel.
3. Outdoor, Noncorrosive Locations: Carbon steel.
4. Outdoor, Corrosive Locations: Type 316 stainless steel.

C. Paint carbon steel channel cut ends prior to installation with zinc-rich primer.

3.15 NAMEPLATES

A. Provide identifying nameplate on all equipment.

3.16 SURGE PROTECTIVE DEVICE (SPD) EQUIPMENT

A. Install in accordance with manufacturer's instructions, including lead length, overcurrent protection, and grounding.

3.17 CONDUIT AND FITTINGS

A. General:

1. Crushed or deformed raceways not permitted.
2. Maintain raceway entirely free of obstructions and moisture.
3. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.
4. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.
5. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.
6. Group raceways installed in same area.
7. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.
8. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.
9. Block Walls: Do not install raceways in same horizontal course with reinforcing steel.
10. Install watertight fittings in outdoor, underground, or wet locations.
11. Paint threads and cut ends, before assembly of fittings, galvanized conduit, PVC-coated galvanized conduit, or IMC installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.
12. Metal conduit to be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.
13. Do not install raceways in concrete equipment pads, foundations, or beams.
14. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.
15. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.
16. Install conduits for fiber optic cables, telephone cables, and Category 6e data cables in strict conformance with the requirements of EIA/TIA 569.

B. Installation in Cast-in-Place Structural Concrete:

1. Minimum cover 2 inches, including all fittings.
2. Conduit placement shall not require changes in reinforcing steel location or configuration.
3. Provide nonmetallic support during placement of concrete to ensure raceways remain in position.
4. Conduit larger than 1-inch shall not be embedded in concrete slabs, walls, foundations, columns or beams, unless approved by Engineer.
5. Slabs and Walls:
    a. Trade size of conduit not to exceed one-fourth of the slab or wall thickness.
    b. Install within middle two-fourths of slab or wall.
    c. Separate conduit less than 2-inch trade size by a minimum ten times conduit trade size, center-to-center, unless otherwise shown.
    d. Separate conduit 2 inches and greater trade size by a minimum eight times conduit trade size, center-to-center, unless otherwise shown.
    e. Cross conduit at an angle greater than 45 degrees, with minimum separation of 1-inch.
    f. Separate conduit by a minimum six times the outside dimension of expansion and deflection fittings at expansion joints.
    g. Conduit shall not be installed below the maximum water surface elevation in walls of water holding structures.
6. Columns and Beams:
    a. Trade size of conduit not to exceed one-fourth of beam thickness.
    b. Conduit cross-sectional area not to exceed 4 percent of beam or column cross section.

C. Conduit Application:

1. Diameter:
    a. Interior Minimum: 3/4-inch.
    b. Exterior Minimum: 1-inch.
2. Outdoor, Exposed:
    a. Rigid galvanized steel.
    b. PVC-coated rigid galvanized steel.
3. Indoor, Exposed: Rigid galvanized steel.
4. Indoor, Concealed (Not Embedded in Concrete): Rigid galvanized steel.
5. Aboveground, Embedded in Concrete Walls, Ceilings, or Floors: Rigid galvanized steel.

6. Direct Earth Burial:
   a. PVC Schedule 40.
   b. PVC-coated rigid galvanized steel.
7. Under Slabs-On-Grade: PVC-coated rigid galvanized steel.
8. Corrosive Areas: PVC-coated rigid galvanized steel.

D. Connections:

1. For motors-, wall-, or ceiling-mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other equipment where flexible connection is required to minimize vibration:
   a. General: Flexible metal, liquid-tight conduit.
   b. Wet or Corrosive Areas: Flexible metal liquid-tight.
   c. Length: 18 inches minimum, 60 inches maximum, sufficient to allow movement or adjustment of equipment.
2. Lighting Fixtures in Dry Areas: Flexible metal, liquid-tight conduit.
3. Outdoor areas, process areas exposed to moisture, and areas required to be oiltight and dust-tight: Flexible metal, liquid-tight conduit.
4. Transition From Underground or Concrete Embedded to Exposed: Rigid galvanized steel conduit.
5. Under Equipment Mounting Pads: Rigid galvanized steel conduit.
6. Exterior Pole Foundations: Rigid galvanized steel conduit.

E. Penetrations:

1. Make at right angles, unless otherwise shown.
2. Notching or penetration of structural members, including footings and beams, not permitted.
3. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack.
4. Entering Structures:
   a. General: Seal raceway at the first box or outlet with oakum or expandable plastic compound to prevent the entrance of gases or liquids from one area to another.
   b. Concrete Roof or Membrane Waterproofed Wall or Floor: Provide watertight seal.
   c. Heating, Ventilating, and Air Conditioning Equipment:
      1) Penetrate equipment in area established by manufacturer.
      2) Terminate conduit with flexible metal conduit at junction box or condulet attached to exterior surface of equipment prior to penetrating equipment.
      3) Seal penetration with approved sealant.
   d. Existing or Precast Wall (Underground): Core drill wall and install watertight entrance seal device.

e. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):
   1) Provide Schedule 40 galvanized pipe sleeve or watertight entrance seal device.
   2) Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint on each side.
f. Handholes:
   1) Metallic Raceways: Provide insulated grounding bushings.
   2) Nonmetallic Raceways: Provide bell ends flush with wall.

F. Support:

1. Support from structural members only, at intervals not exceeding NFPA 70 requirements, and in any case not exceeding 8 feet. Do not support from piping, pipe supports, or other raceways.
2. Multiple Adjacent Raceways: Provide ceiling trapeze. For trapeze-supported conduit, allow 10 percent extra space for future conduit.
3. Application/Type of Conduit Strap:
   a. Steel Conduit: Zinc-coated steel, pregalvanized steel, or malleable iron.
   b. PVC-Coated Rigid Steel Conduit: PVC-coated metal.
   c. Nonmetallic Conduit: Nonmetallic or PVC-coated metal.
4. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:
   a. Wood: Wood screws.
   b. Hollow Masonry Units: Toggle bolts.
   c. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
   d. Steelwork: Machine screws.
   e. Location/Type of Hardware:
      1) Dry, Noncorrosive Areas: Galvanized.
      2) Wet, Noncorrosive Areas: Stainless steel.
      3) Corrosive Areas: Stainless steel.

G. Bends:

1. Install concealed raceways with a minimum of bends in the shortest practical distance.
2. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than 20 times cable diameter, 15 inches minimum.
3. Install with symmetrical bends or cast metal fittings.

4. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.
5. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.
6. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run and raceways are same size.
7. PVC Conduit:
    a. Bends 30 Degrees and Larger: Provide factory-made elbows.
    b. 90-Degree Bends: Provide rigid steel elbows, PVC coated where direct buried.
    c. Use manufacturer's recommended method for forming smaller bends.
8. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

H. Expansion and Deflection Fittings: Provide on all raceways at structural expansion joints and in long tangential runs.

I. PVC Conduit:

1. Solvent Welding:
    a. Provide manufacturer recommended solvent; apply to all joints.
    b. Install such that joint is watertight.
2. Adapters:
    a. PVC to Metallic Fittings: PVC terminal type.
    b. PVC to Rigid Metal Conduit or IMC: PVC female adapter.
3. Belled-End Conduit: Bevel the unbelled end of the joint prior to joining.

J. PVC-Coated Rigid Steel Conduit:

1. Install in accordance with manufacturer's instructions.
2. All tools and equipment used in the cutting, bending, threading, and installation of PVC-coated rigid steel conduit shall be designed to limit damage to the PVC coating.
3. Provide PVC boot to cover all exposed threading.

K. Termination at Enclosures:

1. Cast Metal Enclosure: Provide manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.
2. Nonmetallic, Cabinets, and Enclosures: Terminate conduit in threaded conduit hubs, maintaining enclosure integrity.

3. Sheet Metal Boxes, Cabinets, and Enclosures:
    a. Rigid Galvanized Conduit:
        1) Provide one lock nut each on inside and outside of enclosure.
        2) Install grounding bushing.
        3) Provide bonding jumper from grounding bushing to equipment ground bus or ground pad; if neither ground bus nor pad exists, connect jumper to lag bolt attached to metal enclosure.
        4) Install insulated bushing on ends of conduit where grounding is not required.
        5) Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
        6) Utilize sealing locknuts or threaded hubs on outside of NEMA 3R and NEMA 12 enclosures.
        7) Terminate conduits with threaded conduit hubs at NEMA 4 and 4X boxes and enclosures.
    b. Electric Metallic Tubing: Provide gland compression, insulated connectors.
    c. Flexible Metal Conduit: Provide two-screw type, insulated, malleable iron connectors.
    d. PVC-Coated Rigid Galvanized Steel Conduit: Provide PVC-coated, liquid-tight, metallic connector.
    e. PVC Schedule 40 Conduit: Provide PVC terminal adapter with locknut.
4. Free-Standing Enclosures:
    a. Terminate metal conduit entering bottom with grounding bushing; provide a grounding jumper extending to equipment ground bus or grounding pad.
    b. Terminate PVC conduit entering bottom with bell end fittings.

L. Underground Raceways:

1. Grade: Maintain minimum grade of 4 inches in 100 feet, either from one manhole, handhole, or pull box to the next, or from a high point between them, depending on surface contour.
2. Cover: Maintain minimum 2-foot cover above conduit, unless otherwise shown.
3. Make routing changes as necessary to avoid obstructions or conflicts.
4. Couplings: In multiple conduit runs, stagger so couplings in adjacent runs are not in same transverse line.
5. Union type fittings not permitted.

6. Spacers:
    a. Provide preformed, nonmetallic spacers, designed for such purpose, to secure and separate parallel conduit runs in a trench.
    b. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.
7. Support conduit so as to prevent bending or displacement during backfilling.
8. Installation with Other Piping Systems:
    a. Crossings: Maintain minimum 12-inch vertical separation.
    b. Parallel Runs: Maintain minimum 12-inch separation.
    c. Installation over valves or couplings not permitted.
9. Metallic Raceway Coating: Along entire length, coat with raceway coating.
10. Provide expansion fittings that allow minimum of 4 inches of movement in vertical conduit runs from underground where exposed conduit will be fastened to or will enter building or structure.
11. Provide deflectional/expansion fittings in conduit runs that exit building or structure belowgrade. Conduit from building wall to fitting shall be PVC-coated rigid steel.
12. Backfill: As specified in Section 31 23 23.15, Trench Backfill.

M. Empty Raceways:

1. Provide permanent, removable cap over each end.
2. Provide PVC plug with pull tab for underground raceways with end bells.
3. Provide woven polyester pull cord with sequential footage markings. Minimum pull cord width of 5/8-inch.
4. Identify, as specified in Article Identification Devices, with waterproof tags attached to pull cord at each end, and at intermediate pull point.

N. Identification Devices:

1. Raceway Tags:
    a. Identify origin and destination.
    b. Install at each terminus, near midpoint, and at minimum intervals of every 50 feet of exposed raceway, whether in ceiling space or surface mounted.
    c. Provide corrosion-resistant wire for attachment.
2. Warning Tape: Install approximately 18 inches above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of runs.

O. Raceway Band: Install wherever metallic conduit emerges from concrete slabs. Not required with PVC-coated RGS conduit. Center band at slab surface and install according to manufacturer's instructions.

1. Slip-on Type: Clean conduit surface at installation location. Cut tubing to 4-inch minimum lengths and slip onto raceway prior to slab placement and termination of conduit. Heat-shrink onto conduit.
2. Wrap-around Type: Use where slip-on access to conduit is not possible. Clean conduit surface at installation location. Apply primer. Apply wraps to provide two layers of tape. Neatly finish tape end to prevent unraveling.

3.18 METAL WIREWAYS

A. Install in accordance with manufacturer's instructions.

B. Locate with cover on accessible vertical face of wireway, unless otherwise shown.

3.19 CONDUCTORS AND CABLES

A. Conductor storage, handling, and installation shall be in accordance with manufacturer's recommendations.

B. Do not exceed manufacturer's recommendations for maximum pulling tensions and minimum bending radii.

C. Conduit system shall be complete prior to drawing conductors. Lubricate prior to pulling into conduit. Lubrication type shall be as approved by conductor manufacturer.

D. Terminate all conductors and cables, unless otherwise shown.

E. Do not splice conductors, unless specifically indicated or approved by Engineer.

F. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 12 inches.

G. Wiring within Equipment and Local Control Panels: Remove surplus wire, dress, bundle, and secure.

H. Power Conductor Color Coding:

1. No. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1-1/2 inches to 2 inches wide.
2. No. 8 AWG and Smaller: Provide colored conductors.
3. Colors:
   a. Neutral Wire: White.
   b. Live Wires, 120/240-Volt, Single-Phase System: Black, red.
   c. Live Wires, 120/208-Volt, Three-Phase System: Black, red, or blue.
   d. Live Wires, 277/480-Volt, Three-Phase System: Brown, orange, or yellow.
   e. Ground Wire: Green.

I. Circuit Identification:

1. Circuits Appearing in Circuit Schedules: Identify power, instrumentation, and control conductor circuits, using circuit schedule designations, at each termination and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.
2. Circuits Not Appearing in Circuit Schedules: Assign circuit name based on device or equipment at load end of circuit. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.
3. Method: Identify with sleeves. Taped-on markers or tags relying on adhesives not permitted.

J. Connections and Terminations:

1. Install nylon self-insulated crimp connectors and terminators for instrumentation and control circuit conductors.
2. Tape insulate all uninsulated connections.
3. Install crimp connectors and compression lugs with tools approved by connector manufacturer.

3.20 GROUNDING

A. Grounding shall be in compliance with NFPA 70 and as shown.

B. Ground electrical service neutral at service entrance equipment to supplementary grounding electrodes.

C. Ground each separately derived system neutral to nearest effectively grounded building structural steel member or separate grounding electrode.

D. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.

E. Shielded Instrumentation Cables:

1. Ground shield to ground bus at power supply for analog signal.
2. Expose shield minimum 1-inch at termination to field instrument and apply heat shrink tube.
3. Do not ground instrumentation cable shield at more than one point.

F. Equipment Grounding Conductors: Provide in all conduits containing power conductors and control circuits above 50 volts.

G. Ground Rods: Install full length with conductor connection at upper end. Install one ground rod in each handhole.

3.21 LUMINAIRES AND ACCESSORIES

A. Install in accordance with manufacturer’s recommendations.

B. Install plumb and level at mounting heights shown.

C. Provide proper hangers, pendants, and canopies as necessary for complete installation and meeting specified seismic requirements.

D. Install symmetrically with suspended ceiling pattern in finished areas.

E. Unfinished Areas: Locate luminaires to avoid conflict with other building systems or blockage of luminaire light output.

F. Building Exterior: Provide flush-mounted back box and concealed conduit, unless otherwise shown.

3.22 FIELD QUALITY CONTROL

A. Tests shall be performed in accordance with the requirements of Section 01 91 14, Equipment Testing and Facility Startup.

B. General:

1. Test equipment shall have an operating accuracy equal to, or greater than, requirements established by NETA ATS.
2. Test instrument calibration shall be in accordance with NETA ATS.
3. Perform inspection and electrical tests after equipment has been installed.

4. Perform tests with apparatus de-energized whenever feasible.
5. Inspection and electrical tests on energized equipment are to be:
    a. Scheduled with Engineer prior to de-energization.
    b. Minimized to avoid extended period of interruption to the operating plant equipment.

C. Tests and inspection shall establish that:

1. Electrical equipment is operational within industry and manufacturer's tolerances.
2. Installation operates properly.
3. Equipment is suitable for energization.
4. Installation conforms to requirements of Contract Documents and NFPA 70.

D. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.

E. Adjust mechanisms and moving parts for free mechanical movement.

F. Adjust adjustable relays and sensors to correspond to operating conditions, or as recommended by manufacturer.

G. Verify nameplate data for conformance to Contract Documents.

H. Realign equipment not properly aligned and correct unlevelness.

I. Properly anchor electrical equipment found to be inadequately anchored.

J. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench to manufacturer's recommendations, or as otherwise specified.

K. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.

L. Provide proper lubrication of applicable moving parts.

M. Investigate and repair or replace:

1. Electrical items that fail tests.
2. Active components not operating in accordance with manufacturer's instructions.
3. Damaged electrical equipment.

N. Electrical Enclosures:

1. Remove foreign material and moisture from enclosure interior.
2. Vacuum and wipe clean enclosure interior.
3. Remove corrosion found on metal surfaces.
4. Repair or replace, as determined by Engineer, door and panel sections having damaged surfaces.
5. Replace missing or damaged hardware.

O. Provide certified test report(s) documenting the successful completion of specified testing. Include field test measurement data.

P. Test the following equipment and materials:

1. Conductors: Insulation resistance, No. 4 and larger only.
2. Panelboards, switches, and circuit breakers.
3. Motor controls.
4. Grounding electrodes.
5. Motors.

Q. Controls:

1. Test control and signal wiring for proper termination and function.
2. Test local control panels and other control devices for proper terminations, configuration and settings, and functions.
3. Demonstrate control, monitoring, and indication functions in presence of Owner and Engineer.

R. Balance electrical load between phases on panelboards and mini-power centers after installation.

S. Voltage Testing:

1. When installation is complete and facility is in operation, check voltage at point of termination of electric utility supply system to Project.
2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
3. Record supply voltage for 24 continuous hours.
4. If unbalance exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded conditions more than plus or minus 4 percent of nominal, make written request to electric utility to correct condition.
5. If corrections are not made, obtain written statement from a responsible electric utility official that voltage variations and/or unbalance are within their normal standards.

T. Equipment Line Current:

1. Check line current in each phase for each piece of equipment.
2. If electric utility makes adjustments to supply voltage magnitude or balance, make line current check after adjustments are made.

END OF SECTION

SECTION 26 42 01
PIPE BONDING AND TEST STATIONS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI): 301, Specifications for Structural Concrete.
2. American National Standards Institute (ANSI).
3. American Petroleum Institute (API): SPEC 5L, Specification for Line Pipe.
4. American Water Works Association (AWWA):
   a. C110, Ductile-Iron and Gray-Iron Fittings for Water.
   b. C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. (100 mm) and Larger - Shop Applied.
   c. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 in. Through 144 in. (100 mm Through 3,600 mm).
   d. C216, Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
   e. C217, Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines.
5. American Wood Preservers' Association (AWPA):
   a. C2, Lumber, Timber, Bridge Ties, and Mine Ties-Preservative Treatment by Pressure Processes.
   b. P9, Standards for Solvents and Formulations for Organic Preservative Systems.
6. ASTM International (ASTM):
   a. A497/A497M, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
   b. A615/A615M, Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
   c. B418, Standard Specification for Cast and Wrought Galvanic Zinc Anodes.
   d. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   e. C150, Standard Specification for Portland Cement.
   f. C387/C387M, Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
   g. F436, Standard Specification for Hardened Steel Washers.
7. Concrete Reinforcing Steel Institute (CRSI).

8. NACE International (NACE): RP0169, Control of External Corrosion on Underground or Submerged Metallic Piping Systems.
9. National Electrical Manufacturers Association (NEMA):
    a. C80.1, Electrical Rigid Steel Conduit (ERSC).
    b. TC 2, Electrical Polyvinyl Chloride (PVC) Conduit.
    c. WC 70, Nonshielded Power Cables Rated 2,000 Volts or Less for the Distribution of Electrical Energy.
10. NSF International (NSF).
11. The Society for Protective Coatings (SSPC):
    a. SP 1, Solvent Cleaning.
    b. SP 10, Near-White Blast Cleaning.

1.02 DEFINITIONS

A. Electrical Isolation: Condition of being electrically isolated from other metallic structures (including, but not limited to, piping, reinforcement, casings) and the environment as defined in NACE RP0169.

B. Electrically Continuous Pipeline: Pipeline that has a linear electrical resistance equal to or less than the sum of the resistance of the pipe plus the maximum allowable bond resistance for each joint as specified in this section.

C. Ferrous Metal Pipe: Pipe made of steel or iron, or pipe containing steel or iron as a principal structural material, except reinforced concrete pipe.

D. Foreign-Owned: Buried pipe or cable not specifically owned or operated by Owner.

E. Lead, Lead Wire, Joint Bonds, Pipe Connecting Wires, Cable: Insulated copper conductor; the same as wire.

1.03 SUBMITTALS

A. Action Submittals: Catalog cuts and information for products proposed for use.

B. Informational Submittals:

1. Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
2. Factory test reports for isolation fitting.
3. Field Test Reports, including results of insulator testing.
4. Qualifications of Cathodic Protection Specialist.

1.04 QUALITY ASSURANCE

A. Cathodic Protection Specialist Qualifications: NACE International certified.

1.05 SCHEDULING

A. Specified weld-in fittings may have long delivery times; contact manufacturers and obtain commitments for delivery before scheduling installation.

PART 2 PRODUCTS

2.01 WIRES

A. Conform to applicable requirements of NEMA WC 70.

B. Joint Bond:

1. General: Single-conductor, stranded copper wire with 600-volt HMWPE insulation. Supply joint bonds complete with formed copper sleeve on each end of wire.
2. Push-On, Mechanical, or Flanged Joints: 2 AWG wires, 18 inches long.
3. Flexible Coupling Joints: 2 AWG wires, 24 inches long, with two 12-inch-long HMWPE insulated 12 AWG wire pigtails, as manufactured by Erico Products Inc. (Cadweld), Cleveland, OH.
4. Insulated Flexible Coupling Joints: 8 AWG wire, 18 inches long, with one 12-inch-long HMWPE insulated 12 AWG wire pigtail.

C. Pipe Connecting: Single-conductor, 4 AWG stranded copper wire with 600-volt HMWPE insulation.

D. Test Station: Single-conductor, 12 AWG stranded copper with 600-volt HMWPE insulation and single-conductor, 8 AWG stranded copper with 600-volt HMWPE insulation.

E. Polarization Cells: Single-conductor, 2/0 AWG stranded copper with 600-volt HMWPE insulation.

F. Insulation Colors:

1. Galvanic Anodes: Black.
2. Inlet/Outlet Pipeline Test Wires: White.
3. Overflow Pipeline Test Wires: Blue.
4. Reference Electrodes: Yellow.
5. Insulated Joints: As shown.

G. Wire Labels:

1. Materials shall be suitable for permanent identification.
2. Plastic, paper, or cloth markers will not be permitted.
3. Each pipe test wire shall include pipe diameter and pipe type, reference electrode, casing, or galvanic anode, as applicable.

2.02 CATHODIC PROTECTION TEST STATIONS

A. Post Mounted (Galvanized Steel Channel):

1. Test Box: Cast aluminum suitable for threaded mounting to a 1-inch or larger rigid galvanized conduit.
2. Terminal Block: Plastic or glass-reinforced laminate, 1/4-inch thick with five terminals. Terminals shall have special heads to keep them from turning or shall be easily accessible from both sides of terminal block without requiring its removal. Terminal studs, washers, and nuts shall be Type 304 stainless steel.
3. Mounting Structure: Galvanized 3-inch diameter steel post, 7 feet long with 2-inch by 3-inch threaded reducer.
4. Manufacturer and Product: Testox; 700 series test station.

2.03 PERMANENT REFERENCE ELECTRODES

A. Prepackaged Copper-Copper Sulfate Reference Electrodes:

1. Material: Permanent type, copper-copper sulfate reference electrode suitable for direct burial with a minimum design life of 30 years.
2. Wire: 12 AWG stranded copper wire with yellow, 600-volt RHH/RHW insulation. Wire shall be attached to electrode and insulated with manufacturer’s standard connection. Connection shall be stronger than the wire.
3. Manufacturers and Products:
   a. Borin Manufacturing; Model SRE-007-CUY.
   b. Electrochemical Devices, Inc.; Model UR-CUG-CW.
   c. GMC Electrical, Inc.; Model CU-1-UGPC.

2.04 EXOTHERMIC WELD KITS

A. Weld Kits: Wire-to-pipe connections made by the exothermic welding process. Weld charges and mold size shall be as specified by the manufacturer for various pipe sizes and surface configurations. Weld charges for use on cast and ductile iron are different from those used on steel. Care should be taken during installation to be sure correct charges are used. Exothermic welds shall be Cadweld as manufactured by Erico Products, Inc., Thermoweld as manufactured by Continental Industries, Inc., "or-equal." Duxseal packing as manufactured by Johns Manville or "or equal" shall be used where necessary to prevent leakage of molten weld metal.

B. The shape and charge of the exothermic weld shall be chosen based on the following parameters:

1. Pipe material.
2. Pipe size.
3. Pipe wall thickness.
4. Wire material.
5. Number of strands to be welded.
6. Orientation of weld (vertical or horizontal).

2.05 THERMITE WELD COATING

A. At thermite weld connections where pipe coating has been removed.

B. Material: 100 percent solids, surface tolerant, fast cure epoxy for coating metal and concrete in wet or damp locations.

C. Manufactures and Products:

1. TC 7100 Wet Bond Epoxy as manufactured by The Tapecoat Company.
2. Kop-Coat A-788 as manufactured by Carboline.
3. Protal 7200 or Protal 7125 depentant on temparature conditions as manufactured by Denso.
4. "Or-equal."

2.06 ANCILLARY MATERIALS

A. Wire Connectors: One-piece, tin-plated crimp-on lug connector as manufactured by Burndy Co. or Thomas and Betts.

B. Compression Connectors: No cable splicing allowed. Cables shall be provided at an appropriate length, free of splices.

C. Shunts: 0.01-ohm Holloway Type RS.

2.07 INSULATING JOINTS

A. Insulating Joints: Dielectric unions, flanges, or couplings.

1. Complete assembly shall have an ANSI rating equal to or higher than that of joint and pipeline.
2. Materials shall be resistant for the intended exposure, operating temperatures, and products in the pipeline.

B. Flange Insulating Kits:

1. Flanges: For steel pipe flanges, oversize bolt holes as specified in Section 33 05 01, Conveyance Piping—General. For ductile iron pipe flanges, provide standard hole diameters.
2. Fasteners: In accordance with AWWA C207 or AWWA C110, for steel pipe or ductile iron pipe, respectively. Minimum bolt length shall be the sum of the mating flanges maximum thicknesses, sealing gasket, insulating and steel washer thickness, and depth of the nut plus 1/8 inch minimum before torquing. Since insulating sleeves may not fit over unthreaded portions of fasteners, bolts shall be cut thread full body or threaded rod as required to meet inside diameter dimensions of insulating sleeves specified herein.
3. Gaskets: Full-face Type E with elastomeric sealing element. Sealing element shall be retained in a groove within retainer portion of gasket.
4. Insulating Sleeves: Full-length fiberglass reinforced epoxy (NEMA G-10 grade).
5. Insulating Washers: Fiberglass reinforced epoxy (NEMA G-10 grade).
6. Steel Washers: Plated, hot-rolled steel, 1/8 inch thick.
    a. Provide two washers per bolt for flange diameters equal to or less than 36-inch diameter.
    b. Provide four washers per bolt for flange diameters larger than 36-inch diameter.
7. Manufacturers:
    a. PSI, Houston, TX.
    b. Advance Products and Systems, Lafayette, LA.

C. Tie-rod Insulator: One-piece Minlon insulating sleeve and washer. Provide two hardened steel washers per insulator, ASTM F436, 1/8 inch thick.

2.08 FUNCTIONAL TEST EQUIPMENT

A. Test Equipment:

1. Before construction begins, obtain test equipment necessary for electrical continuity testing, and the following equipment:
   a. Model 702, Buried Insulation Checker, as manufactured by Gas Electronics Co., Seymour, MO.
   b. One Model 77 Series III, Digital Multimeter, with case and test leads, as manufactured by Fluke Corporation, Everett, WA.
   c. Two Model 6B copper-copper sulfate reference electrodes as manufactured by Tinker and Rasor, San Gabriel, CA.
   d. One quart of copper sulfate antifreeze solution.
   e. One-half pound of copper sulfate crystals.

B. Store test equipment at Site and maintain in accurately calibrated, working condition. Test equipment shall be available to Engineer for testing purposes. Upon completion of Project, test equipment listed above shall be turned over to Owner in clean, accurate, and fully functional condition, along with operating manuals, test wires, and cases supplied with equipment.

PART 3 EXECUTION

3.01 INSTALLATION

A. Construct system of functioning test stations to aid in evaluating the performance of the cathodic protection system.

3.02 TEST STATION INSTALLATION

A. Locate test stations as follows:

1. Refer to the Cathodic Protection Schedule Detail (2642-800) on Drawings for details.
2. Actual location of test station may differ slightly from what is listed in the Cathodic Protection Schedule Detail (2642-800) based on actual site conditions and as approved by Engineer.

B. Attach test wires to pipe.

C. Locate flush mounted test stations directly over pipeline, except in areas of heavy traffic conditions. Where heavy traffic conditions exist, locate test stations to side of street.

D. Locate post mounted test stations 5 feet off centerline of pipe and at protected locations such as fences, road crossings, and edges of cultivated land.

E. Bury test and reference electrode wires a minimum of 36 inches below finished grade.

F. Make wire connections to test station terminals with crimp-on spade lug terminals, except where solid wire is specified or terminal strips with tubular clamps are used.

G. Wire Labels:

1. Install on conductors in boxes.
2. Position markers in boxes so they do not interfere with operation and maintenance.

3.03 CONDUITS

A. Secure conduits entering test station boxes with double locknuts, one on outside and one on inside.

B. Install insulated bushings and insulated throat connectors on ends of rigid metallic conduit.

C. Use watertight couplings and connectors. Install and equip boxes and fitting to prevent water from entering conduit or box. Seal unused openings.

3.04 REFERENCE ELECTRODE INSTALLATION

A. Remove plastic or paper wrapper and place reference electrode within pipeline trench excavation 6 inches from below centerline of pipe in a vertical or horizontal position. Install reference electrode within 18 inches of foreign pipelines or as directed by Engineer, between foreign and Owner’s pipeline.

B. Measure the accuracy of each copper/copper sulfate reference electrode before installation by measuring the direct current (dc) voltage difference between it and one or more reference electrodes of known accuracy. The measurements shall be less than plus or minus 0.010 dc volts for all reference electrodes. Perform these measurements after totally submerging the reference electrodes in a 5-gallon bucket of potable water for a minimum period of 20 minutes. Brackish water or saltwater shall not be allowed. This testing shall be performed by the Contractor’s Corrosion Engineer and witnessed by the Owners’ Representative.

C. Install the copper/copper sulfate reference electrodes per the manufacturer's guidelines. Provide a minimum 12 inches of slack wire around the reference electrode to allow for movement during backfill and soil compaction. Exercise care so as not to damage or pierce the insulation of the reference electrode lead wire. Cover the reference electrode with 6 inches of native rock-free soil and saturate it with a minimum 5 gallons of potable water.

3.05 WIRE CONNECTIONS

A. Thermite Weld:

1. Use thermite weld method for electrical connection of copper wire to steel, ductile, and cast-iron surfaces. Observe proper safety precautions, welding procedures, thermite weld material selection, and surface preparation recommended by welder manufacturer. Ensure that pipe or fitting wall thickness is of sufficient thickness that thermite weld process will not damage integrity of pipe or fitting wall or protective lining.
2. After weld connection has cooled, remove slag, visually inspect, and physically test wire connection by tapping with a hammer; remove and replace defective connections.
3. On pipe and fittings with dielectric linings, make weld connection on shop tab provided or on a thick metal section to minimize damage to lining and coating. After weld is made, coat weld with coating repair material.
4. Install prefabricated thermite weld cap over each completed connection. Repair exposed metal surfaces not covered by thermite weld cap in accordance with coating manufacturer's recommendations. Repair damage to pipe lining in accordance with lining applicator's recommendations.
5. Make wire connections to concrete cylinder pipe by thermite welding to shop welded steel studs or plates provided on pipe for this purpose. Clean steel studs to bright metal before thermite welding. Coat completed wire connection with cement mortar.

3.06 WIRE INSULATION REPAIR

A. Handle wires with care. If wires are damaged, the wire shall be replaced entirely.

3.07 INSULATED JOINTS

A. Install insulated joints to electrically isolate pipeline from other structures. Locate insulated joints at connections to existing metallic pipe, where cathodically protected pipe connects to pipe not intended to have cathodic protection, and where shown.

B. Align and install insulating joints as shown on Drawings and according to manufacturer's recommendations.

C. Do not use fastener lubricants that contain graphite or metallic compounds that will interfere with the insulating capability of the completed joint.

D. Test the completed insulating joint as specified herein.

E. Insulating Flange Lining and Coating:

1. After assembly of insulated flanges, repair coatings and linings as shown on Drawings and as specified herein.
   a. Interior Lining: For cement mortar linings, prepare cement-mortar surface in accordance with paint manufacturer's instructions and apply a 20-mil minimum thickness of NSF potable water approved, 100 percent solids water or air curing epoxy coating to interior of pipeline. Apply coating for a minimum of two pipe diameter lengths from insulating flange in both directions. Apply and cure coating in accordance with manufacturer's recommendations. Do not apply coating where it will interfere with operation of pipeline valves or other pipeline assemblies.
   b. Exterior Coating: For buried insulating flanges, coat completed joint with petroleum wax tape in accordance with AWWA C217.

3.08 FIELD QUALITY CONTROL

A. Insulated Joint Testing:

1. Provide Engineer with 3 days' advance notice before beginning tests.
2. Test each joint after assembly with insulator tester in accordance with manufacturer's written instructions.
3. For insulating flanges, test and record insulating values of each bolt in addition to the completed flange.
4. Replace damaged or defective insulation parts.
5. Correct defects identified during testing.

END OF SECTION

SECTION 26 42 02
GALVANIC ANODE CATHODIC PROTECTION SYSTEM

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. B843, Standard Specification for Magnesium Alloy Anodes for Cathodic Protection.
   b. G97, Standard Test Method for Laboratory Evaluation of Magnesium Sacrificial Anode Test Specimens for Underground Applications.
2. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

1.02 DEFINITIONS

A. Ferrous Metal Pipe: Pipe made of steel or iron, and pipe containing steel or iron as a principle structural material, except reinforced concrete.

B. Lead, Lead Wires, Joint Bonds, Cable: Insulated copper conductor; the same as wire.

C. Pipe Section: A single fitting or a single piece of pipe less than 20 feet in length. Pipe Sections between 20 feet and 40 feet in length shall be treated as two Pipe Sections. Each 20 feet of pipe and fittings with joint bonds may be treated as one Pipe Section.

1.03 SUBMITTALS

A. Action Submittals: Catalog cuts and other information for products to be used.

B. Informational Submittals:

1. Compliance Statement: Provide compliance statement that galvanic anode composition meets chemical requirements specified herein.
2. Test data for open circuit potential measurements and electrochemical capacity for high potential magnesium anodes, as specified herein.
3. Field test reports.
4. Cathodic Protection Specialist qualifications.

1.04 QUALITY ASSURANCE

A. Cathodic Protection Specialist Qualifications: National Association of Corrosion Engineers (NACE) certified.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Provide electrode packaged in a plastic or heavy paper bag of sufficient thickness to protect electrode, backfill, and cloth bag during normal shipping and handling.

B. Store prepackaged anodes off the ground and keep them dry. Protect against weather, condensation, and mechanical damage. Immediately remove wet or mechanically damaged prepackaged anodes from Site. Handle anodes with care to prevent loss of backfill material. Do not lift or hold anodes by lead wire.

PART 2 PRODUCTS

2.01 GALVANIC ANODES

A. Magnesium Anodes:

1. Composition: High potential magnesium, ASTM B843, Grade M1C.
2. Open Circuit Potential and Electrochemical Capacity:
   a. Open Circuit Potential: Negative 1.70 volts or more negative to a copper-copper sulfate reference electrode.
   b. Electrochemical Capacity: 490 ampere hours at 50 percent efficiency, minimum.
   c. As determined by laboratory testing using ASTM G97.
3. Dimensions:
   a. Packaged Length: 60 inches minimum.
   b. Bare Weight: 60 pounds minimum.

B. Anode Wire: Furnish each anode with 12 AWG solid copper wire with HMWPE insulation, long enough to terminate at the structure being cathodically protected with at least 1-foot of slack.

C. Wire-to-Anode Connection: Manufacturer’s standard. Anode connection shall be stronger than the wire.

D. Backfill:

1. Composition:
   a. Ground Hydrated Gypsum: 75 percent.
   b. Powdered Wyoming Bentonite: 25 percent.
   c. Anhydrous Sodium Sulfate: 5 percent.
2. Grain Size: 100 percent passing through a 20-mesh screen and 50 percent retained by a 100-mesh screen.
3. Mixture: Thoroughly mixed and firmly packaged around galvanic anode within cloth bag by means of adequate vibration.
4. Quantity of backfill shall be sufficient to cover surfaces of anode to a depth of 1 inch.

2.02 ANCILLARY MATERIALS

A. Compression Connectors:

1. For in-line, tap, and multisplice compression connectors furnish “C” taps made of conductive wrought copper, sized to fit wires being spliced.
2. Manufacturer and Product: Burndy; Type YC.

B. Wire Connectors: One-piece, tin-plated crimp-on lug connector as manufactured by Burndy Co. or Thomas and Betts.

C. Wire Insulation coating:

1. Splicing Tape: Linerless rubber high-voltage splicing tape suitable for moist and wet environments; Scotch 130C and Scotch 88, as manufactured by 3M Products.
2. Epoxy splice kit Inline or Wye, as required, suitable for moist and wet environments, as manufactured by 3M Products.

D. Shunts: 0.01-ohm Holloway Type RS.

E. Earthfill: Native soil free of roots and other organic matter, ashes, cinders, trash, debris, and rocks.

2.03 THERMITE WELD MATERIALS

A. General:

1. Thermite wire sleeves, welders, and weld cartridges according to manufacturer’s recommendations for each wire size, pipe or fitting size, and material.

2. Welding materials and equipment shall be the product of a single manufacturer. Interchanging materials of different manufacturers will not be acceptable.

B. Molds: Graphite. Ceramic “One-Shot” molds are not acceptable.

C. Cartridges:

1. Cast-iron thermite weld cartridges for cast and ductile iron pipe and fittings.
2. Maximum Cartridge Size:
   a. 32 grams for steel material.
   b. 45 grams for cast and ductile iron materials.

D. Welding Materials Manufacturers:

1. Erico Products Inc. (Cadweld), Cleveland, OH.
2. Continental Industries, Inc. (Thermo-Weld), Tulsa, OK.

2.04 COATING REPAIR MATERIAL FOR PIPE AND FITTINGS

A. As recommended by pipe or fitting coating manufacturer for spot damage at thermite weld connections not covered by standard pipeline coating repair procedure.

B. Material: 100 percent solids epoxy that cures in submerged or buried conditions.

C. Manufacturers and Products:

1. Carboline, St. Louis, MO; Carboguard A-788 Splash Zone Mastic.
2. Raven Linings, Tulsa, OK; Aquatapoxy A-7.

PART 3 EXECUTION

3.01 GENERAL

A. Construct galvanic anode cathodic protection system on buried steel pipe and appurtenances.

B. Conform to NFPA 70.

3.02 GALVANIC ANODE INSTALLATION

A. General:

1. Install anodes at locations shown on Drawings.
2. Install galvanic anodes 1 foot below pipe invert and 5 feet from pipeline.
3. Alternate anode placement on opposite sides of pipe.
4. Provide minimum anode spacing of 2 feet from other unprotected pipelines.
5. Thoroughly compact earthfill around each anode to a point 1 foot above anode. Stop backfill below grade to allow for placing of topsoil, when required.
6. Bury anode wires a minimum of 24 inches below finish grade.

3.03 WIRE CONNECTIONS TO PIPE

A. Make electrical connection of copper wire to steel, ductile, and cast iron surfaces using thermite weld method. Observe proper safety precautions, welding procedures, thermite weld material selection, and surface preparation as recommended by manufacturer. Assure pipe or fitting wall thickness is of sufficient thickness that thermite weld process will not damage integrity of pipe or fitting wall or protective lining.

B. Before connection is made, clean surface to bare metal by making a 2-inch by 2-inch window in coating, and then filing or grinding surface to produce a bright metal finish. Grinding shall be with a vitrified type grinding wheel; use of resin, rubber, or shellac impregnated type grinding wheels is not acceptable. Prepared metal surface shall be dry.

C. Install wire sleeves on the ends of the wires before welding to metal surface. Perform thermite welding in strict accordance with manufacturer’s written instructions. After weld connection has cooled, remove slag and physically test wire connection by tapping with a hammer; remove and replace defective connections.

D. Install prefabricated thermite weld cap over each completed connection. Repair exposed metal surfaces not covered by thermite weld cap in accordance with coating manufacturer’s recommendations. Repair damage to pipe lining in accordance with lining applicator’s recommendations.

3.04 WIRE INSULATION REPAIR

A. Splices are not allowed. Replace all anodes with damaged cable with a new anode.

3.05 FIELD TESTING

A. Provide Cathodic Protection Specialist to visit Site during installation of galvanic anode cathodic protection system. Cathodic Protection Specialist shall be responsible to ensure compliance with these Specifications, and for observation and testing services.

END OF SECTION

SECTION 31 10 00
SITE CLEARING

PART 1 GENERAL

1.01 DEFINITIONS

A. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.

B. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.

C. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2-inch caliper to a minimum depth of 6 inches below subgrade.

D. Scalping: Removal of sod without removing more than upper 3 inches of topsoil.

E. Stripping: Removal of topsoil remaining after applicable scalping is completed.

F. Project Limits: Areas, as shown or specified, within which Work is to be performed.

1.02 SUBMITTALS

A. Action Submittals: Drawings clearly showing clearing, grubbing, and stripping limits.

1.03 QUALITY ASSURANCE

A. Obtain Engineer’s approval of staked clearing, grubbing, and stripping limits, prior to commencing clearing, grubbing, and stripping.

1.04 SCHEDULING AND SEQUENCING

A. Prepare Site only after adequate erosion and sediment controls are in place.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Clear, grub, and strip areas actually needed for waste disposal, borrow, or Site improvements within limits shown or specified. All topsoil must be removed in areas where there are surface improvements or finished grade varies from existing grade.

B. Do not injure or deface vegetation that is not designated for removal.

3.02 LIMITS

A. As follows, but not to extend beyond Work limits.

1. Excavation Excluding Trenches: 5 feet beyond top of cut slopes.
2. Trench Excavation: 2 feet beyond top edge of trench excavation, regardless of actual trench width.
3. Fill:
   a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
   b. Stripping and Scalping: 2 feet beyond toe of permanent fill.
4. Waste Disposal:
   a. Clearing: 5 feet beyond perimeter.
   b. Scalping and Stripping: Not required.
   c. Grubbing: Around perimeter as necessary for neat finished appearance.
5. Structures: 5 feet outside of new structures.

B. Remove rubbish, trash, and junk from entire area within Work limits.

3.03 CLEARING

A. Clear areas within limits shown or specified.

B. Fell trees so that they fall away from facilities and vegetation not designated for removal.

C. Cut stumps not designated for grubbing flush with ground surface.

D. Cut off shrubs, brush, weeds, and grasses to within 2 inches of ground surface.

3.04 GRUBBING

A. Grub areas within limits shown or specified.

3.05 SCALPING

A. Do not remove sod until after clearing and grubbing is completed and resulting debris is removed.

B. Scalp areas within limits shown or specified.

3.06 STRIPPING

A. Do not remove topsoil until after scalping is completed.

B. Strip areas within limits to minimum depths shown or specified. Do not remove subsoil with topsoil. All topsoil must be removed.

C. Stockpile strippings, meeting requirements of Section 32 91 13, Soil Preparation, for topsoil, separately from other excavated material.

3.07 DISPOSAL

A. Clearing and Grubbing Debris:

1. Dispose of debris offsite.
2. Burning of debris onsite will not be allowed.
3. Limit offsite disposal of clearing and grubbing debris to locations that are approved by federal, state, and local authorities, and that will not be visible from Project.

B. Scalpings: As specified for clearing and grubbing debris.

C. Strippings:

1. Dispose of strippings that are unsuitable for topsoil or that exceed quantity required for topsoil offsite.
2. Stockpile topsoil in sufficient quantity to meet Project needs. Dispose of excess strippings as specified for clearing and grubbing.

END OF SECTION

SECTION 31 23 13
SUBGRADE PREPARATION

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM): D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

1.02 DEFINITIONS

A. Optimum Moisture Content: As defined in Section 31 23 23, Fill and Backfill.

B. Prepared Ground Surface: Ground surface after completion of clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and scarification and compaction of subgrade.

C. Relative Compaction: As defined in Section 31 23 23, Fill and Backfill.

D. Relative Density: As defined in Section 31 23 23, Fill and Backfill.

E. Subgrade: Layer of existing soil after completion of clearing, grubbing, scalping of topsoil prior to placement of fill, roadway structure or base for floor slab.

F. Proof-Rolling: Testing of subgrade by moving vehicle to identify areas that will not support the future loading without excessive settlement.

G. Unsuitable Material: Refers to 1) in situ or Site soil materials that are unsuitable as foundation or subgrade materials because of their density, moisture content, organic content, plasticity, or gradation; and 2) soil (onsite or imported) that is not suitable as fill or backfill because it does not meet the requirements of the Specifications.

1.03 SEQUENCING AND SCHEDULING

A. Complete applicable Work specified in Section 31 10 00, Site Clearing, and Section 31 23 16, Excavation, prior to subgrade preparation.

1.04 QUALITY ASSURANCE

A. Notify Engineer when subgrade is ready for compaction or proof-rolling or whenever compaction or proof-rolling is resumed after a period of extended inactivity.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Prepare subgrade when unfrozen and free of ice and snow.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Keep subgrade free of water, debris, and foreign matter during compaction or proof-rolling.

B. Bring subgrade to proper grade and cross-section and uniformly compact surface.

C. Do not use sections of prepared ground surface as haul roads. Protect prepared subgrade from traffic.

D. Maintain prepared ground surface in finished condition until next course is placed.

3.02 PROOF-ROLLING

A. Subgrades under fill, footings, slabs, tanks and pavements shall be proof-rolled prior to placement of fill, footings, tanks and pavements using a heavily loaded vehicle. The vehicle must have a loaded gross vehicle weight (GVW) of 40,000 pounds with a loaded single axle weight of at least 18,000 pounds and a minimum tire pressure of 90 pounds per square inch (psi). Vehicle must complete a minimum of two passes in opposite directions over each area.

B. Any loose, soft, or yielding areas identified by proof-rolling shall be compacted in place or removed and replaced with granular fill.

A. Subgrades that cannot be proof-rolled shall be probed and observed by Processional Observation as specified in Section 01 45 33, Special Inspection, Observation and Testing.

3.03 MOISTURE CONDITIONING

A. Dry Subgrade: Add water, then mix to make moisture content uniform throughout.

B. Wet Subgrade: Aerate material by blading, discing, harrowing, or other methods, to hasten drying process.

3.04 CORRECTION

A. Soft or Loose Subgrade:

1. Adjust moisture content and recompact.
2. Over excavate as specified in Section 31 23 16, Excavation, and replace with suitable material from the excavation, as specified in Section 31 23 23, Fill and Backfill.

B. Unsuitable Material: Over excavate as specified in Section 31 23 16, Excavation, and replace with suitable material from the excavation, as specified in Section 31 23 23, Fill and Backfill.

END OF SECTION

SECTION 31 23 16
EXCAVATION

PART 1 GENERAL

1.01 DEFINITIONS

A. Excavation: Removal of material required to perform the work. All excavations are unclassified and the Contractor is required to excavate all material regardless of type of material encountered.

B. There is a possibility of encountering excavated soils that contain elevated levels of lead and arsenic as a result of mining processing operation at Kennecott. When encountered, these excavated soils shall be disposed offsite as specified herein.

C. “Clean” soil, i.e., soil having no known impact from a current or historic spill or release. Upon removal, clean soil is also defined as having:

1. No observational staining.
2. No odor indicative of contamination.
3. Analytical data of organic hazardous substances (for example, petroleum hydrocarbons, volatile organic compounds (VOCs), chlorinated solvents, pesticides, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs) are zero or non-detect.
4. Analytical data of inorganic hazardous substances, i.e., metals are at or below background concentrations. Background concentrations are site-specific and are based on background soil samples collected at a site where no spills or releases have occurred, to determine natural levels of inorganics including metals concentrations. If required, background soil concentrations must be established through the use of Utah Department of Environmental Quality (UDEQ) and US Environmental Protection Agency (EPA) methods and/or approved by UDEQ.

D. “Contaminated” soil, i.e., soil where current and/or historic information indicates a substance release or practices occurred which could have resulted in a chemical or contaminant impact to the soil, or where analytical data indicate concentrations of chemical or contaminant is above the detection limit for organic hazardous substances or background concentrations for inorganic hazardous substances.

E. Overexcavation: Excavation beyond lines, grades and dimensions on Drawings and Specifications.

1.02 SUBMITTALS

A. Informational Submittals:

1. Excavation Plan, Detailing:
   a. Methods and sequencing of excavation.
   b. Proposed locations of stockpiled excavated material.
   c. Proposed onsite and offsite spoil disposal sites.
2. Soil Materials Management Plan (SMMP), Detailing:
   a. Proposed locations of excavated contaminated soil.
   b. Proposed offsite contaminated soil disposal site(s).
   c. Sampling and analysis for characterization and disposal of contaminated soil.
   d. Transportation and disposal requirements for contaminated soil.
   e. Requirements of the SMMP are included as a supplement to this specification following the End of Section.
3. Spoil and Contaminated Soil Transportation and Disposal Documents:
   a. Disposal Facility approved waste profiles and/or waste stream approval letters.
   b. Executed manifests (with transporter and disposal facility signatures) and Certificates of Disposal/Destruction (CD).

1.03 QUALITY ASSURANCE

A. Provide adequate survey control to avoid unauthorized overexcavation.

1.04 WEATHER LIMITATIONS

A. Material excavated when frozen or when air temperature is less than 32 degrees F shall not be used as fill or backfill until material completely thaws.

B. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

1.05 SEQUENCING AND SCHEDULING

A. Clearing, Grubbing, and Stripping: Complete applicable Work specified in Section 31 10 00, Site Clearing, prior to excavating.

B. Dewatering: Conform to applicable requirements of Section 31 23 19.01, Dewatering, prior to initiating excavation.

C. Excavation Support: Install and maintain, as specified in Section 31 41 00, Shoring, as necessary to support sides of excavations and prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Excavate to lines, grades, and dimensions shown and as necessary to accomplish Work. Excavate to within tolerance of plus or minus 0.1 foot, except where dimensions or grades are shown or specified as maximum or minimum. Allow for forms, working space, granular base, topsoil, and similar items, wherever applicable. Trim to neat lines where concrete is to be deposited against earth.

B. Do not over-excavate without written authorization of Engineer.

C. Remove or protect obstructions as shown and as specified in Section 01 50 00, Temporary Facilities and Controls.

D. Use of explosives and blasting is not allowed.

3.02 UNCLASSIFIED EXCAVATION

A. Excavation is unclassified. Complete all excavation regardless of the type, nature, or condition of the materials encountered.

3.03 TRENCH WIDTH

A. Minimum Width of Trenches:

1. As shown on Drawings.
2. Increase trench widths by thicknesses of sheeting and shoring.

B. Maximum Trench Width: Unlimited, unless otherwise shown or specified, or unless excess width will cause damage to existing facilities, adjacent property, or completed Work.

3.04 EMBANKMENT AND CUT SLOPES

A. Shape, trim, and finish cut slopes to conform with lines, grades, and cross-sections shown, with proper allowance for topsoil or slope protection, where shown.

B. Remove stones and rock that exceed 3-inch diameter and that are loose and may roll down slope. Remove exposed roots from cut slopes.

C. Round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend offsite or outside easements and rights-of-way, or adversely impacts existing facilities, adjacent property, or completed Work.

3.05 STOCKPILING EXCAVATED MATERIAL

A. Excavated material is not allowed to be stockpiled within existing street right-of-way or public traveled areas. Do not obstruct any roadways or street. Conform to federal, state, and local codes governing the safe loading of trenches with excavated material. Stockpile excavated material that is suitable for use as fill or backfill until material is needed.

B. Post signs indicating proposed use of material stockpiled. Post signs that are readable from all directions of approach to each stockpile. Signs should be clearly worded and readable by equipment operators from their normal seated position.

C. Confine stockpiles to within approved work areas. Do not obstruct roads or streets.

D. Do not place or stockpile excavated material adjacent to trenches and other excavations, unless excavation side slopes and excavation support systems are designed, constructed, and maintained for stockpile loads.

E. Do not place or stockpile excavated materials near or over existing facilities, adjacent property, or completed Work, if weight of stockpiled material could induce excessive settlement.

F. Segregate soils based on anticipated management/disposal to the extent possible, and in a manner that allows access for testing.

G. Manage stockpiled soils destined for off-site disposal to remove free liquids such that their physical characteristics will not result in a failure of a paint filter test. Liquids drained from such material shall be managed in accordance with the approved SMMP.

3.06 EXCAVATION OF BASTIAN AND MASCOTTE DITCH SOILS

A. Excavated soils along the Bastian and Mascotte Ditches contain elevated levels of lead and arsenic as a result of mining processing operations from Kennecott South Zone, a CERCLA Superfund site operable unit, located upstream. Contaminated soils with high lead levels continue to be found in the OU5 (Bastian) and OU6 (Mascotte) Operable Units on the Districts site. The Contractor shall develop and implement a soils material management plan (SMMP) as outlined in the supplement following End of Section of this specification section.

B. UDEQ and EPA have established risk based cleanup levels for contaminated soils which are documented in the provided Terracon report.

C. Coordination and final approval with UDEQ and EPA is required to determine the appropriate level for use at this site. For purposes of this bid, it is assumed that contaminated soil concentrations, based on laboratory sampling and analysis, at or above residential use levels will require removal and offsite disposal. It is also assumed that contaminated soil concentrations, based on laboratory sampling and analysis, below residential use levels can be placed back into excavations. Decisions are to be documented in SMMP.

D. Elevated levels of arsenic and lead remain a potential threat to construction workers, the public and the environment during excavation of soils in the area. Actions should be taken to protect both site workers, the public and the environment from soils containing potentially high concentrations of lead and arsenic during construction activities in this area. In addition, sampling of excavated soils will be required to characterize the material to determine if it can be placed back into the excavation or if it must be disposed of offsite at the Clean Harbors, Grassy Mountain Landfill Site. Planned actions to be documented in SMMP.

E. Contractor to assume responsibility for protection of site workers and the public during excavation of soils at the site. During construction, the following activities are suggested as a minimum:

1. Dust mitigation and monitoring.
2. Good housekeeping, sanitation at site.
3. Wash hands before eating.
4. No eating or drinking at site.
5. Segregate wastes, keep separate from public access and clean soils by using roll-offs or dump trucks.
6. Limit exposure of site workers to particulates containing potentially high concentrations of arsenic and lead.

7. Stock piled soils shall be placed on plastic, covered and contained to prevent contamination with surrounding environment.
8. Equipment used to manage contaminated soils must be properly decontaminated.

F. Additional precautions or activities may be necessary in order to fully comply with the Contractor's policies, Owner's policies, occupational safety and health requirements and State and federal environmental laws and regulations.

G. In addition, sampling of excavated spoils or contaminated soils to determine toxicity using sampling methods and collection procedures consistent with the requirements of the waste disposal facility are required, including the type and number of samples. Composite soil samples of excavated materials will require analysis from a Utah certified laboratory for metals using by EPA's SW-846 Test Methods 1311/6020/7471B to determine the initial levels of arsenic and lead in excavated soils. Samples will be collected at a frequency of one per 10 drums or 1 per roll-off container.

3.07 TRANSPORTATION OF SPOIL AND CONTAMINATED SOIL

A. The work encompassed by this specification involves transportation and disposal of spoil and/or contaminated soil. This material will be staged in steel UN-approved 55-gallon drums, roll-off boxes or direct loaded into dump trucks.

B. All trucks must be clean and shall not have any leaks.

C. Trucks are to be inspected upon arrival to project site. Any truck found to be inadequate, at Owners discretion, will be turned away. Owner is not responsible for any costs associated with any delays caused by delivery of inadequate trucks or equipment. It is expected that transportation of contaminated soil will be provided on a less-than truckload (LTL)/milk-run basis.

D. Containers used for waste disposal must be in good condition (clean, no leaks, not damaged, etc.). Movement of containers is the responsibility of the Contractor.

E. Roll-off boxes must be delivered to project site in good condition (clean, no leaks, etc.). Roll-offs shall have liners, bows, and tarps which also must be in good condition (no tears, holes, fit properly, etc.). Roll-off boxes shall be inspected upon arrival and roll-off boxes that are not in good condition or which arrive with contents and/or contamination will not be loaded and turned away with the costs borne by the Contractor/subcontractor, at the sole discretion of the Owner.

F. Demurrage will not be paid by Owner unless the demurrage is directly the cause of the Owner. Require 2 hours loading time at a minimum. Off-loading demurrage shall be the responsibility of the transporter.

G. All trucks will be required to have applicable placards relative to the waste stream indicated on the manifest and provided by Contractor/subcontractor. Placarding is only required if waste is characterized as hazardous.

H. Transporters shall adhere by and be in compliance with all regulatory requirements under 49 CFR and applicable state regulations.

I. Documentation indicating that the selected transporter and all lower tier subcontractors have appropriate licenses as a commercial transporter of hazardous waste (DOT number, with Hazardous certification and USEPA ID number). Transporter will be in satisfactory standing with DOT. This information will be provided with the bid response.

J. Transporters will be required to abide by all health and safety requirements and project specific transportation routes including appropriate signage and speed limits, as established by the Contractor.

3.08 DISPOSAL OF SPOIL AND CONTAMINATED SOIL

A. Dispose of excavated materials, which are unsuitable or exceed quantity needed for fill or backfill, offsite.

B. Dispose of debris resulting from removal of underground facilities offsite at a facility approved to accept these materials and at no additional cost to the Owner.

C. Dispose of debris resulting from removal of organic matter, trash, refuse, and junk as specified in Section 31 10 00, Site Clearing, for clearing and grubbing debris.

D. Dispose of contaminated soils with elevated level of lead and arsenic at the Clean Harbors facility located at Grassy Mountain Landfill Facility.

E. The Generator of contaminated soils is Owner. Contractor is responsible for providing pre-printed manifests and all appropriate transportation and disposal documentation (e.g., waste profiles, manifests, etc., as required by disposal facility) for signature by Owner’s representative, after review by Engineer.

F. Contractor to submit copies of approved waste profiles and/or letter for approval of shipment from disposal facility of each waste stream. Note: Bills of lading are not to be used for any waste or contaminated soil removed from project site. All waste and contaminated soil must be removed using nonhazardous and hazardous waste manifests.

G. Contractor to submit executed manifests (with transporter and disposal facility signatures) and Certificates of Disposal/Destruction (CD). Copies of this information shall be sent to the attention of the appropriate Owner Project Manager. Originals shall be sent directly to Owner (generator) via means of trackable mail such as Federal Express or UPS. Original facility signed manifests will not be attached to invoices.

3.09 SUPPLEMENT

A. The supplement listed below is included as a supplement to the Contract Documents and is considered a part of this Specification.

1. Soil Management Plan from Terracon Dated January 2023.

END OF SECTION

SECTION 31 23 19.01
DEWATERING

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. UPDES General Permit for Construction Dewatering/Hydrostatic Testing of Pipelines.
2. Water Control Plan which is a description and system layout drawing for the proposed dewatering system. It includes proposed methods, description of piping, wells, pumps, discharge locations, pollution control, and other components.
3. For bypass pumping, submit design calculations demonstrating adequacy of proposed dewatering systems and components.

B. If system is modified during installation or operation, revise or amend and resubmit Water Control Plan.

1.02 PERMITS

A. Obtain UPDES General Permit for Construction Dewatering/Hydrostatic Testing of Pipelines and UPDES Construction Stormwater Permit as specified in Section 01 51 00, Permits.

B. Discharge permits.

1.03 WATER CONTROL PLAN

A. As a minimum, include:

1. Descriptions of proposed groundwater and surface water control facilities including, but not limited to, equipment; methods; standby equipment and power supply, pollution control facilities, discharge locations to be utilized, and provisions for immediate temporary water supply as required by this section.
2. Drawings showing locations, dimensions, and relationships of elements of each system.
3. Design calculations demonstrating adequacy of proposed dewatering systems and components.

B. If system is modified during installation or operation revise or amend and resubmit Water Control Plan.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Comply with all permits for treatment control and discharge of water from dewatering operations and hydrostatic testing of pipelines.

B. Pipeline Construction: Continuously control water during course of construction, including weekends and holidays and during periods of work stoppages, and provide adequate backup systems to maintain control of water.

C. For Other Portions of Project: Remove and control water during periods when necessary to properly accomplish Work.

3.02 SURFACE WATER CONTROL

A. See Section 01 50 00, Temporary Facilities and Controls, Article Temporary Controls.

B. Remove surface runoff controls when no longer needed.

3.03 DEWATERING SYSTEMS

A. Provide, operate, and maintain dewatering systems of sufficient size and capacity to permit excavation and subsequent construction in dry and to lower and maintain groundwater level a minimum of 2 feet below the lowest point of excavation. Continuously maintain excavations free of water, regardless of source, and until backfilled to final grade.

B. Design and Operate Dewatering Systems:

1. To prevent loss of ground as water is removed.
2. To avoid inducing settlement or damage to existing facilities, completed Work, or adjacent property.
3. To relieve artesian pressures and resultant uplift of excavation bottom.

C. Provide sufficient redundancy in each system to keep excavation free of water in event of component failure.

D. Provide 100 percent emergency power backup with automatic startup and switchover in event of electrical power failure.

E. Provide supplemental ditches and sumps only as necessary to collect water from local seeps. Do not use ditches and sumps as primary means of dewatering.

3.04 MONITORING WELLS

A. Monitoring Groundwater Levels: Contractor may install and monitor observation wells at locations approved by the Engineer.

B. After groundwater level observation wells are no longer needed for monitoring groundwater levels, abandon observation wells, as required by Utah Administrative Code (UAC) R655-4-14.

3.05 MONITORING FLOWS

A. Monitor volume of water pumped per calendar day from excavations, as Work progresses. Also monitor volume of water introduced each day into excavations for performance of Work. Monitor flows using measuring devices acceptable to Engineer.

3.06 DISPOSAL OF WATER

A. Obtain discharge permit for water disposal from authorities having jurisdiction.

B. Treat water collected by dewatering operations, as required by regulatory agencies, prior to discharge.

C. Discharge water as required by discharge permit and in manner that will not cause erosion or flooding, or otherwise damage existing facilities, completed Work, or adjacent property.

D. Remove solids from treatment facilities and perform other maintenance of treatment facilities as necessary to maintain their efficiency.

3.07 PROTECTION OF PROPERTY

A. Make assessment of potential for dewatering induced settlement. Provide and operate devices or systems, including but not limited to reinjection wells, infiltration trenches and cutoff walls, necessary to prevent damage to existing facilities, completed Work, and adjacent property.

B. Securely support existing facilities, completed Work, and adjacent property vulnerable to settlement due to dewatering operations. Support shall include, but not be limited to, bracing, underpinning, or compaction grouting.

END OF SECTION

SECTION 31 23 23
FILL AND BACKFILL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C117, Standard Test Method for Materials Finer Than 75-Micrometers (No. 200) Sieve in Mineral Aggregates by Washing.
   b. C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
   c. D75, Standard Practice for Sampling Aggregates.
   d. D1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
   e. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   f. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
   g. D4254, Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
   h. D6598, Standard Guide for Installing and Operating Settlement Points for Monitoring Vertical Deformations.
   i. D6938, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.02 DEFINITIONS

A. Borrow Material: Material from required excavations or from designated borrow areas on or near Site.

B. Completed Course: A course or layer that is ready for next layer or next phase of Work.

C. Embankment Material: Fill materials required to raise existing grade in areas other than under structures.

D. Geosynthetics: Geotextiles, geogrids, or geomembranes.

E. Imported Material: Materials obtained from sources offsite, suitable for specified use.

F. Influence Area:

1. Area within planes sloped downward and outward at 60-degree angle from horizontal measured from:
   a. 1 foot outside outermost edge at base of foundations or slabs.
   b. 1 foot outside outermost edge at surface of roadways or shoulder.
   c. 0.5 foot outside exterior at spring line of pipes or culverts.

G. Lift: Loose (uncompacted) layer of material.

H. Optimum Moisture Content:

1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.
2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.

I. Prepared Ground Surface: Ground surface after completion of required demolition, clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and subgrade preparation.

J. Relative Compaction:

1. Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D1557.
2. Apply corrections for oversize material to either as-compacted field dry density or maximum dry density, as determined by Engineer.

K. Relative Density: Calculated in accordance with ASTM D4254 based on maximum index density determined in accordance with ASTM D4253 and minimum index density determined in accordance with ASTM D4254.

L. Selected Backfill Material: Materials available onsite that Engineer determines to be suitable for specific use.

M. Settlement Plate (Gauge): A system meeting the guidelines of ASTM D6598 consisting of a steel plate at an elevation of interest with an extendible riser pipe of known length.

N. Structural Fill: Fill materials as required under structures, pavements, and other facilities.

O. Well-Graded:

1. A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes.
2. Does not define numerical value that must be placed on coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.
3. Used to define material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

1.03 SUBMITTALS

A. Action Submittals:

1. Samples: All fill and backfill materials proposed to be used in the Work to demonstrate material conformance with these Specifications. Sample sizes shall be as determined by the Engineer, unless otherwise indicated herein.
2. Submit Cold Weather Construction Plan addressing all earthwork to be conducted in freezing temperatures, including methods for maintaining ground and CLSM above 40 degrees for cold weather placement and curing of CLSM and concrete.

B. Informational Submittals:

1. Catalog and manufacturer’s data sheets for compaction equipment.
2. Certified Analyses of Gradation, Compaction, and Atterberg Limits: Submit not less than 30 days prior to delivery for imported materials or 30 days prior to anticipated use for excavated materials. Sampling shall be in accordance with ASTM D75.
3. Description and location of proposed sources of imported material.
4. Description of equipment and location of the proposed materials processing operation.
5. Description of material testing work plan and program including, as a minimum, onsite and offsite soils/materials laboratory testing facility locations, facility details, laboratory and field testing certification, and experience of testing personnel.
6. Results of Contractor’s quality control testing, including test locations, test depth (in reference to finish grade), test method, and results.
7. Name and qualifications of Contractor’s independent field and materials testing firm.
8. West Tank Subgrade Preloading (Settlement Monitoring) plan.
9. Settlement plate Shop Drawings.
10. Settlement plate survey data and plots of data.

1.04 QUALITY CONTROL

A. Contractor shall retain an independent certified field and materials testing firm to perform all field, source, and laboratory testing necessary.

B. All tests necessary for the Contractor to locate an acceptable source of imported material shall be made by the Contractor. All material samples shall be furnished by the Contractor at the Contractor's sole expense. Samples shall be representative and be clearly marked to show the source of the material and the intended use on the Project. Sampling of the material source shall be done by the Contractor in accordance with ASTM D75. Notify the Engineer at least 24 hours prior to sampling. The Engineer may, at the Engineer's option, observe the sampling procedures. Tentative acceptance of the material source shall be based on an inspection of the source by the Engineer and/or the certified test results submitted by the Contractor to the Engineer, at the Engineer's discretion. No imported materials shall be delivered to the site until the proposed source and materials tests have been tentatively accepted in writing by the Engineer. Final acceptance will be based on tests made on samples of material taken from the completed and compacted course.

C. Gradation tests by the Contractor shall be made on samples taken at the place of production or borrow area prior to transport or stockpiling. Samples of the finished product for gradation testing shall be taken from each 1,500 tons of prepared materials, or as identified in the Specifications, or more often as determined by the Engineer if variation in gradation is occurring, or if the material appears to depart from the Specifications. Test results shall be forward to the Engineer within 48 hours after sampling.

D. If tests conducted by the Contractor or the Engineer indicate that the material does not meet Specification requirements, material placement will be terminated until corrective measures are taken. Material which does not conform to the Specification requirements and is placed in the Work shall be removed and replaced at the Contractor's sole expense. Sampling and testing performed by the Contractor shall be done at the Contractor's sole expense.

E. Laboratory Tests Required:

1. Earthfill and Select Earthfill: The following tests shall be performed for each principal type of material or combination of materials utilized as Earthfill.
    a. Compaction test (ASTM D1557).
    b. Atterberg Limits (ASTM D4318).
    c. Gradation test (ASTM D422).

2. Additional Materials: Gradation test (ASTM C136 and ASTM C117) and compaction test (ASTM D1557) shall be performed for each principal type of material or combination of materials utilized as:
   a. Granular drain material or drain rock (compaction test not required).
   b. Granular fill.
   c. Pipe bedding and pipe zone material.
   d. Trench stabilization or foundation stabilization rock (compaction test not required).

F. Field Tests Required:

1. Where in-place, soil material is required to be compacted to a percentage of maximum density. The maximum density at optimum moisture content will be determined in accordance with ASTM D1557.
2. Structure Excavation, Filling, and Backfilling:
   a. One in-place density test and one in-place moisture test per 100 square yards per lift, but no more than 10 tests per lift.
   b. In-place density and moisture tests within the structure (a) may be utilized as the in-place density and moisture tests indicated in, and (b) if they happen to coincide within the subarea.
3. Site Grading:
   a. Excavation, filling, raw subgrade, and base course preparation under paved areas: One in-place density test and one in-place moisture test per 2,000 square yards per lift.
   b. Excavation, filling, and raw subgrade preparation under grassed or nontraffic areas: One in-place density test and one in-place moisture test per 3,000 square yards per lift.
4. Nuclear methods for determining in-place density may be used for a maximum of 90 percent of the required tests. The remaining tests shall be correlation check tests of the nuclear test results by use of the sand-cone method, as per ASTM D1556. The minimum depth for sand cone test holes shall be 12 inches. The minimum test hole diameter shall be 8 inches. Sand used for the test shall be size 16/30 or 10/20 silica sand.
5. Additional in-place density and moisture content shall be performed as directed by the Engineer.

G. Samples for laboratory and field tests shall be taken at locations designated by the Engineer.

H. Contractor shall repeat quality control tests that fail to meet Specifications at no additional cost to the Owner.

I. Submit copies of Contractor’s soil test results.

1.05 QUALITY ASSURANCE

A. Notify Engineer when:

1. Structure or tank is ready for backfilling, and whenever backfilling operations are resumed after a period of inactivity.
2. Soft or loose subgrade materials are encountered wherever embankment or site fill is to be placed.
3. Fill material appears to be deviating from Specifications.

1.06 SEQUENCING AND SCHEDULING

A. Complete applicable Work specified in Section 31 10 00, Site Clearing, Section 31 23 16, Excavation, and Section 31 23 13, Subgrade Preparation, prior to placing fill or backfill.

B. Backfill against concrete structures only after concrete has attained compressive strength, specified in Section 03 30 00, Cast-in-Place Concrete. Obtain Engineer's acceptance of concrete work and attained strength prior to placing backfill.

C. Do not place granular base, subbase, or surfacing until after subgrade has been prepared as specified in Section 31 23 13, Subgrade Preparation.

PART 2 PRODUCTS

2.01 EARTHFILL

A. Excavated material from required excavations free from rocks larger than 3 inches, from roots and other organic matter, ashes, cinders, trash, debris, and other deleterious materials.

B. Unless otherwise indicated on Drawings and Specifications, all fills shall be earth fill as defined herein.

2.02 SELECT EARTH FILL

A. As specified in Section 31 23 23.15, Trench Backfill.

2.03 GRANULAR FILL

A. Granular fill shall be free from clay balls and have the following gradation:

Sieve Size	Percent Passing By Weight
1 inch	100
3/8 inch	50 – 100
No. 4	20 – 65
No. 40	10 – 30
No. 200	5 – 12

2.04 SAND

A. Free from clay, organic matter, or other deleterious material.

B. Gradation as determined in accordance with ASTM C117 and ASTM C136:

Sieve Size	Percent Passing by Weight
1/4-inch	100
No. 4	95 - 100
No. 200	0 - 8

2.05 DRAIN ROCK OR GRANULAR DRAIN MATERIAL

A. As specified in Section 31 23 23.15, Trench Backfill.

2.06 WATER FOR MOISTURE CONDITIONING

A. Free of hazardous or toxic contaminates, or contaminants deleterious to proper compaction.

2.07 BASE COURSE ROCK

A. As specified in Section 32 11 23, Aggregate Base Courses.

2.08 TRENCH STABILIZATION MATERIAL

A. As specified in Section 31 23 23.15, Trench Backfill.

2.09 TOPSOIL

A. As specified in Section 32 91 13, Soil Preparation.

2.10 NATIVE TOPSOIL

A. As specified in Section 32 91 13, Soil Preparation.

2.11 SETTLEMENT PLATE

A. Base Plate: 1/2-inch-thick steel plate, 36 inches square in size.

B. Riser Pipe: 1-1/2-inch steel riser pipe that is welded in position perpendicular to the base plate at its center.

C. Isolation Casing: An external pipe with removable cap used to isolate the riser pipe from the surrounding soil. Prevents the effects of extraneous sources of movement such as frost-induced heave, skin-friction due to compression within the fill itself, or moisture induced volume changes. Metal, PVC or other lightweight pipe materials are acceptable.

PART 3 EXECUTION

3.01 GENERAL

A. Keep placement surfaces free of water, debris, and foreign material during placement and compaction of fill and backfill materials.

B. Place and spread fill and backfill materials in horizontal lifts of uniform thickness, in a manner that avoids segregation, and compact each lift to specified densities prior to placing succeeding lifts. Slope lifts only where necessary to conform to final grades or as necessary to keep placement surfaces drained of water.

C. During filling and backfilling, keep level of fill and backfill around each structure and buried tank even.

D. Do not place fill or backfill, if fill or backfill material is frozen, or if surface upon which fill or backfill is to be placed is frozen.

E. If pipe, conduit, duct bank, or cable is to be laid within fill or backfill:

1. Fill or backfill to an elevation 2 feet above top of item to be laid.
2. Excavate trench for installation of item.
3. Install bedding, if applicable, as specified in Section 31 23 23.15, Trench Backfill.
4. Install item.
5. Backfill envelope zone and remaining trench, as specified in Section 31 23 23.15, Trench Backfill, before resuming filling or backfilling specified in this section.

F. Tolerances:

1. Final Lines and Grades: Within a tolerance of 0.1 foot unless dimensions or grades are shown or specified otherwise.
2. Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted.

G. Settlement: Correct and repair any subsequent damage to structures, pavements, curbs, slabs, piping, and other facilities, caused by settlement of fill or backfill material.

3.02 BACKFILL UNDER AND AROUND STRUCTURES

A. Prepare subgrade in accordance with Section 31 23 13, Subgrade Preparation.

B. Backfill pipelines in accordance with Section 31 23 23.15, Trench Backfill.

C. Under Concrete Structures and Asphalt: Within influence area beneath concrete structures, structural concrete slabs, and other similar type facilities, provide minimum 6-inch thick layer of granular fill. Place granular fill in lifts of maximum 6-inch thickness and compact each lift to minimum of 95 percent relative compaction as determined in accordance with ASTM D1557.

D. Adjacent to Structures:

1. Within the influence area of pavement and structures backfill with granular fill or aggregate base course to the lines and grades shown, with proper allowance for road zone and pavement restoration where shown. Place in lifts of 6-inch maximum thickness and compact to 95 percent relative compaction as determined in accordance with ASTM D1557.
2. Outside the influence area of structures and pavement backfill with earthfill to the lines and grades shown, with proper allowance for topsoil where shown. Place in lifts of 8-inch maximum thickness and compact to 90 percent relative compaction as determined in accordance with ASTM D1557.

E. Subsurface Drainage: Backfill with granular drain material only where shown or indicated on Drawings. Place granular drain material in lifts of 6-inch maximum thickness and compact each lift to minimum of 90 percent relative density.

F. Other Areas: Backfill with earthfill to lines and grades shown, with proper allowance for topsoil thickness where shown. Place in lifts of 8-inch maximum thickness and compact each lift to minimum 90 percent relative compaction as determined in accordance with ASTM D1557.

3.03 FILL

A. Outside Influence Areas beneath Structures, Tanks, Pavements, Curbs, Slabs, Piping, and Other Facilities:

1. Unless otherwise shown, place earthfill as follows:
   a. Allow for thickness of topsoil where required.
   b. Maximum 8-inch thick lifts.
   c. Place and compact fill across full width of embankment.
   d. Compact to minimum 90 percent relative compaction as determined in accordance with ASTM D1557.
   e. Dress completed embankment with allowance for topsoil, crest surfacing, and slope protection, where applicable.

3.04 GRANULAR BASE, SUBBASE, AND SURFACING

A. Place and Compact as specified in Section 32 11 23, Aggregate Base Courses.

3.05 COLD WEATHER LIMITATIONS IN COMPACTING FILL AND BACKFILL

A. No frozen subgrades are allowed. No frozen moisture is allowed in any fill.

B. Unless allowed in the authorized Cold Weather Construction Plan, earth fills and backfills requiring 95 percent or higher relative compaction shall not be placed when either atmospheric temperature, or the temperature of the existing ground or the fill being placed, are below 32 degrees F unless both the existing ground and the fill being placed are both nonfrost susceptible materials.

C. Earth fills and backfills requiring 90 percent or lower relative compaction may be placed when temperatures are below 32 degrees F if the required compaction is achieved. If the required compaction is not achieved, the Work shall be removed and recompacted until the required compaction is achieved.

D. Do not place CLSM, concrete, or any fill of backfill materials which require 95 percent, or higher, relative compaction if the excavation or subgrade contains frozen moisture (snow, ice, sleet, etc.), frozen earthen materials, or earthen materials which have been deposited in the excavation due to freezing, thawing, precipitation, or other inappropriate means. Do not place fill materials which contain frozen moisture (snow, ice, sleet, etc.).

3.06 REPLACING OVEREXCAVATED MATERIAL

A. Replace excavation carried belowgrade lines shown or established by Engineer as follows:

1. Beneath Footings: Concrete fill as specified in Section 03 30 00, Cast-in-Place Concrete.
2. Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.
3. Beneath Slabs-On-Grade: Granular fill.
4. Trenches:
    a. Unauthorized Overexcavation: Either trench stabilization material or granular pipe base material, as specified in Section 31 23 23.15, Trench Backfill.
    b. Authorized Overexcavation: Trench stabilization material, as specified in Section 31 23 23.15, Trench Backfill.
5. Permanent Cut Slopes (Where Overlying Area is Not to Receive Fill or Backfill):
    a. Flat to Moderate Steep Slopes (3:1, Horizontal Run: Vertical Rise or Flatter): Earthfill.
    b. Steep Slopes (Steeper than 3:1):
        1) Correct overexcavation by transitioning between overcut areas and designed slope adjoining areas, provided such cutting does not extend offsite or outside easements and rights-of-ways, or adversely impacts existing facilities, adjacent property, or completed Work.
        2) Backfilling overexcavated areas is prohibited, unless in Engineer’s opinion, backfill will remain stable, and overexcavated material is replaced as compacted earthfill.

3.07 WEST TANK SUBGRADE PRELOADING

A. Place settlement monitoring plates at locations indicated on Drawings.

B. Remove topsoil for the fill area of the west reservoir and install settlement monitoring plates on prepared subgrade which will be below existing grade. Place soil from the east reservoir stockpile onto the west reservoir area to the same elevation as the top of reservoir.

C. Monitor settlement of the base plates every week during fill placement. Continue weekly monitoring of the base plates until there is less than 1/4-inch of settlement, then transition to monitoring every two weeks. Preconsolidation is considered complete when there is less than 1/8-inch of settlement for two consecutive readings.

END OF SECTION

SECTION 31 23 23.15
TRENCH BACKFILL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Public Works Association (APWA): Uniform Color Code.
2. ASTM International (ASTM):
   a. C33/C33M, Standard Specification for Concrete Aggregates.
   b. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   c. C117, Standard Test Method for Materials Finer than 75 Micrometer (No. 200) Sieve in Mineral Aggregates by Washing.
   d. C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   e. C150/C150M, Standard Specification for Portland Cement.
   f. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
   g. C1012/C1012M, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.
   h. D75, Standard Practice for Sampling Aggregates.
   i. D1140, Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75 micrometer) Sieve.
   j. D1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
   k. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   l. D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
   m. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
   n. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
   o. D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
   p. D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
   q. D6938, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

3. National Electrical Manufacturers Association (NEMA): Z535.1, Safety Colors.

1.02 DEFINITIONS

A. Base Rock: Granular material upon which manhole bases and other structures are placed.

B. Bedding Material: Granular material or CLSM upon which pipes, conduits, cables, or duct banks are placed.

C. Imported Material: Material obtained by Contractor from source(s) offsite.

D. Lift: Loose (uncompacted) layer of material.

E. Pipe Zone: Backfill zone that includes full trench width and extends from prepared trench bottom to an upper limit above top outside surface of pipe, conduit, cable or duct bank.

F. Prepared Trench Bottom: Graded trench bottom after excavation and installation of stabilization material, if required, but before installation of bedding material.

G. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by ASTM D1557. Corrections for oversize material may be applied to either as-compacted field dry density or maximum dry density, as determined by Engineer.

H. Relative Density: As defined by ASTM D4253 and ASTM D4254.

I. Selected Backfill Material: Material available onsite that Engineer determines to be suitable for a specific use.

J. Well-Graded: A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes producing a material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids. Satisfying both of the following requirements, as defined in ASTM D2487:

1. Coefficient of Curvature: Greater than or equal to 1 and less than or equal to 3.
2. Coefficient of Uniformity: Greater than or equal to 4 for materials classified as gravel, and greater than or equal to 6 for materials classified as sand.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Manufacturer’s descriptive literature for marking tapes.
2. Samples: All fill and backfill materials to be used in the work to demonstrate material conformance with these Specifications. Sample size shall be determined by the Engineer, unless otherwise indicated herein.
3. Submit Cold Weather Construction Plan addressing all earthwork to be conducted in freezing temperatures, including methods for maintaining ground and CLSM above 40 degrees for cold weather placement and curing of CLSM and concrete.

B. Informational Submittals:

1. Catalog and manufacturer’s data sheets for compaction equipment.
2. Certified Gradation Analysis, Compaction, Atterberg Limits, and Corrosivity: Submit not less than 30 days prior to delivery for imported materials or 30 days prior to anticipated use for excavated materials.
3. Controlled Low Strength Material (CLSM):
    a. Certified mix design and test results. Include material types and weight per cubic yard for each component of mix along with 2-day and 28-day compressive strength in accordance with ASTM D4832.
    b. For Native Soil Used in Production of CLSM: Certified test results and reports from independent testing agency (quality control) along with 2-day and 28-day compressive strength in accordance with ASTM D4832. Provide results of laboratory classification and corrosion testing along with description of sample location (referenced to the Project stationing) for each native soil sample obtained.
4. Description and location of proposed sources of imported material.
5. Description of equipment and location of the proposed materials processing operation.
6. Documentation that imported material is free of hazardous substances.
7. Results of Contractor’s quality control testing, including test locations, test depth (in reference to finish grade), test method, and results.
8. Name and qualifications of Contractor’s independent field and materials testing firm.

1.04 QUALITY CONTROL

A. Contractor shall retain an independent certified field and materials testing firm to perform all field, source, and laboratory testing necessary.

B. All tests necessary for the Contractor to locate an acceptable source of imported material shall be made by the Contractor. All material samples shall be furnished by the Contractor at the Contractor's sole expense. Samples shall be representative and be clearly marked to show the source of the material and the intended use on the project. Sampling of the material source shall be done by the Contractor in accordance with ASTM D75. Notify the Engineer at least 24 hours prior to sampling. The Engineer may, at the Engineer's option, observe the sampling procedures. Tentative acceptance of the material source shall be based on an inspection of the source by the Engineer and/or the certified test results submitted by the Contractor to the Engineer, at the Engineer's discretion. No imported materials shall be delivered to the site until the proposed source and materials tests have been tentatively accepted in writing by the Engineer. Final acceptance will be based on tests made on samples of material taken from the completed and compacted course.

C. Gradation tests by the Contractor shall be made on samples taken at the place of production or borrow area prior to transport or stockpiling. Samples of the finished product for gradation testing shall be taken from each 1,500 tons of prepared materials, or as identified in the specifications, or more often as determined by the Engineer if variation in gradation is occurring, or if the material appears to depart from the specifications. Test results shall be forward to the Engineer within 48 hours after sampling.

D. If tests conducted by the Contractor or the Engineer indicate that the material does not meet specification requirements, material placement will be terminated until corrective measures are taken. Material which does not conform to the specification requirements and is placed in the Work shall be removed and replaced at the Contractor's sole expense. Sampling and testing performed by the Contractor shall be done at the Contractor's sole expense.

E. Laboratory Tests Required:

1. Earthfill: The following tests shall be performed for each principal type of material or combination of materials utilized as earthfill, but not less than 5 samples:
    a. Compaction test (ASTM D1557).
    b. Atterberg Limits (ASTM D4318).
    c. Gradation test (ASTM D422).

2. Bedding Material and Pipe Zone Material: The following tests shall be performed for each principal type of material or combination of materials utilized as bedding material and pipe zone material:
   a. Compaction test (ASTM D1557).
   b. Gradation test (ASTM C136).
3. Select Earthfill for Use in CLSM:
   a. If the Contractor elects to utilize select earthfill in place of, or in conjunction with, commercial aggregate in CLSM, the Contractor shall perform the following tests for each principal type of material or combination of materials anticipated to be utilized as select earthfill material in CLSM:
      1) Atterberg Limits (ASTM D4318).
      2) Gradation test (ASTM D422).
      3) Chloride, in accordance with EPA Test Method 300.0.
      4) Sulfate, in accordance with EPA Test Method 300.0.
      5) pH, in accordance with ASTM G51.
      6) Minimum resistivity, in accordance with ASTM G187.
   b. The Contractor shall submit a minimum of 10 samples of select earthfill obtained from along the alignment at locations considered by the Contractor to be representative of the material to be used in CLSM. Additional samples shall be submitted during the Work if the material to be used as select earthfill in CLSM deviates from the submitted samples as determined by the Contractor or the Engineer.
4. Trench Backfill Material:
   ~~.~~a. The following tests shall be performed for each principal type of material or combination of materials utilized as trench backfill material:
      ~~0)~~1) Compaction test (ASTM D1557).
      ~~0)~~2) Gradation test (ASTM C136).

F. Field Tests Required:

1. Where in-place, soil material is required to be compacted to a percentage of maximum density. The maximum density at optimum moisture content will be determined in accordance with ASTM D1557.
2. Trench Excavation and Backfilling:
   a. One in-place density test and one in-place moisture test per 100 linear feet of trench per lift under structures, embankments, and paved areas.
   b. One in-place density test and one in-place moisture test per 300 linear feet of trench per lift under grassed or nontraffic areas.
   c. For Trenches Wider Than 6 Feet: One in-place density test and one in-place moisture test per 1,000 square feet of trench per 2 feet of backfill under structures, embankments, and paved areas.

d. For Trenches Wider Than 6 Feet: One in-place density test and one in-place moisture test per 2,000 square feet of trench per 2 feet of backfill under grassed or nontraffic areas.

3. Nuclear methods for determining in-place density may be used for a maximum of 90 percent of the required tests. The remaining tests shall be correlation check tests of the nuclear test results by use of the sand-cone method, as per ASTM D1556. The minimum depth for sand cone test holes shall be 12 inches and the minimum test hole diameter shall be 8 inches. Sand used for the test shall be size 16/30 or 10/20 silica sand.
4. Additional in-place density and moisture content shall be performed as directed by the Engineer.

G. CLSM Mix Design Information Required:

1. If the Contractor elects to utilize select earthfill in place of, or in conjunction with, commercial aggregate in CLSM, the Contractor shall obtain samples of each principal type of select earthfill anticipated to be used in CLSM, as discussed previously, and submit a mix design for each principal type of select earthfill that conforms with the requirements for CLSM.
2. Additional mix designs shall be submitted during the Work if the material to be used as select earthfill in CLSM deviates from the submitted samples as determined by the Contractor or the Engineer, or if other CLSM mix components are modified.

1.05 QUALITY ASSURANCE

A. Notify the Engineer when:

1. Soft or loose subgrade materials are encountered.
2. Fill and backfill material appears to deviate from the specifications.
3. Quality control test results indicate noncompliance with required specifications.

B. During the course of the Work, the Engineer will perform such tests as are required to identify materials, to determine compaction characteristics, to determine moisture content, and to determine density of fill and backfill in place. These tests performed by the Engineer will be used to verify that the work conforms to the requirements of the specifications (quality assurance). Such tests are not intended to provide the Contractor with the information required by Contractor for the proper execution of the Work and their performance shall not relieve the Contractor of the necessity to perform tests for that purpose.

C. Soil testing frequency for quality assurance shall be as directed by Engineer.

D. The Contractor shall provide safe access in the excavation for the soil compaction testing technician or inspector. This shall include providing safety equipment and temporary shoring to enable compaction testing at multiple levels in the excavation as directed by Engineer. Should the Contractor have backfilled to an elevation above that required to be tested, the Contractor shall excavate the backfill down to the necessary level for testing and provide shoring at his cost. Subsequent backfilling shall also be at the Contractor's cost.

E. The Contractor shall provide safe access for the Engineer to the offsite materials source locations to obtain independent samples for testing.

F. In the event that the first quality assurance test performed at an individual location shows noncompliance with the required specifications, the Contractor shall accomplish such remedy as may be required to ensure compliance. The second quality assurance test to verify compliance at that location will also be at the Owner's expense, however in the event of noncompliance at that location subsequent testing by the Engineer at that location will be at the Contractor's expense.

1.06 WEATHER LIMITATIONS

A. Material excavated during inclement weather or below 32 degrees F shall not be used as fill or backfill until the material drains and dries sufficiently for proper compaction.

B. Saturated native materials that are over optimum moisture content shall be dried or blended with drier material before being considered suitable.

PART 2 PRODUCTS

2.01 GEOTEXTILE

A. As specified in Section 31 32 19.16, Geotextile.

2.02 MARKING TAPE

A. Nondetectable:

1. Inert polyethylene, impervious to known alkalis, acids, chemical reagents, and solvents likely to be encountered in soil.
2. Thickness: Minimum 5 mils.
3. Width: 6 inches.
4. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.

5. Manufacturers and Products:
   a. Reef Industries; Terra Tape.
   b. Mutual Industries; Non-detectable Tape.
   c. Presco; Non-detectable Tape.

B. Detectable:

1. Solid aluminum foil, visible on unprinted side, encased in protective high visibility, inert polyethylene plastic jacket.
2. Foil Thickness: Minimum 0.35 mils.
3. Laminate Thickness: Minimum 5 mils.
4. Width: 6 inches.
5. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
6. Joining Clips: Tin or nickel-coated furnished by tape manufacturer.
7. Manufacturers and Products:
   a. Reef Industries; Terra Tape, Sentry Line Detectable.
   b. Mutual Industries; Detectable Tape.
   c. Presco; Detectable Tape.

C. Color: In accordance with APWA Uniform Color Code.

Color*	**Facility**
Red	Electric power lines, cables, conduit, and lightning cables
Orange	Communicating alarm or signal lines, cables, or conduit
Yellow	Gas, oil, steam, petroleum, or gaseous materials
Green	Sewers and drain lines
Blue	Potable water
Purple	Reclaimed water, irrigation, and slurry lines
*As specified in NEMA Z535.1, Safety Color Code.	

2.03 TRACER WIRE

A. Material: Minimum 12-gauge solid copper or copper jacket with a steel core, with high-density polyethylene (HDPE) or high-molecular weight polyethylene (HMWPE) insulation suitable for direct bury.

B. Splices: Use wire nut or lug suitable for direct burial as recommended by tracer wire manufacturer.

C. Manufacturers:

1. Copperhead Industries, LLC.
2. Performance Wire & Cable Inc.
3. Pro-line Safety Products Company.

2.04 TRENCH STABILIZATION MATERIAL

A. Clean, hard, durable 3-inch minus crushed rock or gravel, or pit run, free from clay balls, other organic materials, or debris.

B. Uniformly graded from coarse to fine, less than 8 percent by weight passing the 1/4-inch sieve.

2.05 BEDDING MATERIAL AND PIPE ZONE MATERIAL

A. Bedding material and Pipe zone material shall have a pH between 7.0 and 10.0. Unless specifically indicated otherwise on Drawings, all bedding material and pipe zone material shall be CLSM. Where CLSM is not required, bedding material and pipe zone material may be CLSM or native processed or imported granular material, defined as well graded sands and gravels meeting ASTM D3282 A-1-a group classifications, with 1-inch maximum particle size and shall contain between 15 percent and 5 percent fines passing the No. 200 sieve (per ASTM C117) that will bind material when compacted. Open graded or poorly graded materials such as washed pea gravel (squeegee) will not be allowed.

2.06 TRENCH ZONE MATERIAL

A. Under asphalt pavement and highway shoulders (to 10 feet from edge of asphalt) and within the road right-of-way use imported or processed excavated soils meeting ASTM D3282 A-1-a or A-1-b group classifications with maximum 4-inch particle size.

B. Elsewhere, use earth fill as specified in Section 31 23 23, Fill and Backfill, with no material larger than 6 inches in the greatest dimension will be allowed in the trench zone. Do not use materials with expansion index over 40 per ASTM D4829.

2.07 DRAIN ROCK OR GRANULAR DRAIN MATERIAL

A. Gradation: ASTM C117 and ASTM C136.

Sieve Size	Percent Passing By Weight
2 inches	100
1-1/2 inches	90 - 100
1 inch	20 - 55
3/4 inch	0 - 15
3/8 inch	0 - 5

2.08 EARTH BACKFILL

A. Earthfill as specified in Section 31 23 23, Fill and Backfill.

2.09 SELECT EARTHFILL

A. Earthfill, Meeting the Following Additional Requirements:

1. Maximum 3-inch particle size, except when used for making CLSM maximum size shall be 1-inch.
2. Less than 35 percent by weight passing the No. 200 sieve.
3. If more than 12 percent by weight passes the No. 200 sieve, the fraction of material passing the No 40 sieve shall have a Plasticity Index not greater than 4, as determined in accordance with ASTM D4318.

2.10 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

A. Select and proportion ingredients to obtain compressive strength between 50 psi and 150 psi at 28 days in accordance with ASTM D4832.

B. Materials:

1. Portland Cement: ASTM C150, Type V (or Type II/V) up to 75 pounds per cubic yard.
2. Aggregate: Concrete sand, processed material from the excavation, imported sand, or a combination thereof meeting the grading requirements of ASTM C33 sand for fine aggregate. A combination of ASTM C33 fine aggregate and Table 2 size 7 or size 8 course aggregate is also acceptable. The soluble sulfate content shall not exceed 0.3 percent by dry weight.

3. Fly Ash: Class C or Class F per ASTM C618, up to 300 pounds per cubic yard.
4. Water: Clean, potable, containing less than 500 ppm of chlorides.

2.11 CONCRETE BACKFILL

A. Provide as specified in Section 03 30 00, Cast-in-Place Concrete.

2.12 IMPERVIOUS BARRIERS

A. Where shown on Drawings, construct impervious barriers (trench cutoffs) at least 36 inches thick of CLSM. Impervious barriers shall consist of a collar cast around the pipe and extended at least 18 inches beyond the limits of the excavated trench as detailed on Drawings.

2.13 AGGREGATE BASE COURSE OR UNTREATED BASED COURSE

A. As specified in Section 32 11 23, Aggregate Base Courses.

2.14 TOPSOIL

A. As specified in Section 32 91 13, Soil Preparation.

2.15 SOURCE QUALITY CONTROL

A. Perform gradation analysis in accordance with ASTM C136 for:

1. Earth backfill, including specified class.
2. Trench stabilization material.
3. Bedding and pipe zone material.

B. Certify Laboratory Performance of Mix Designs:

1. Controlled low strength material.
2. Concrete.

PART 3 EXECUTION

3.01 COMPACTION REQUIREMENTS

A. Unless otherwise shown on Drawings or otherwise described in the specifications for the particular type of pipe installed, relative compaction in pipe trenches shall be as follows (relative compaction values are per ASTM D1557 and per Section 31 23 23, Fill and Backfill):

1. Pipe Zone and Pipe Bedding (except CLSM): 92 percent relative compaction.

2. Backfill in Trench Zone not beneath Structures, Tanks, Pavement, Sidewalks, Culverts and Pipelines: 90 percent relative compaction.
3. Backfill in Trench Zone and Street Zone beneath Structures, Tanks, Pavement, Sidewalks, Culverts and Pipelines: 95 percent relative compaction.
4. Backfill in Pavement Zone Under Asphalt: 95 percent relative compaction.
5. Rock Refill for Contractor Overexcavation and for Foundation Stabilization: 95 percent relative compaction (use 80 percent relative density if open graded rock is required).
6. Topsoil Replaced: Match density of adjacent topsoil.
7. All backfill placed soil for compaction shall be between 1 percent below and 2 percent above optimum moisture content.

B. Compact trench backfill to the specified relative compaction. Compact by using mechanical compaction, or hand tamping. Do not use water jetting for compaction. Do not use high impact hammer-type equipment except where the pipe manufacturer warrants in writing that such use will not damage the pipe.

C. Compact material placed within 12 inches of the outer surface of the pipe by hand operated tampers or other equipment that will not damage the pipe.

D. Do not use any axle-driven or tractor-drawn compaction equipment within 5 feet of building walls, foundations, and other structures.

3.02 TRENCH PREPARATION

A. Water Control:

1. As specified in Section 31 23 19.01, Dewatering.
2. Remove water in a manner that minimizes soil erosion from trench sides and bottom.
3. Provide continuous water control until trench backfill is complete.

B. Remove foreign material and backfill contaminated with foreign material that falls into trench.

3.03 TRENCH BOTTOM

A. Firm Subgrade: Remove loose and disturbed material, and trim off high areas and ridges left by excavating bucket teeth. Allow space for bedding material as shown or specified.

B. Soft Subgrade: If subgrade is encountered that may require removal to prevent pipe settlement, notify Engineer. Engineer will determine depth of overexcavation, if any required.

3.04 GEOTEXTILE INSTALLATION

A. Where shown and as specified in Section 31 32 19.16, Geotextile, except as follows:

1. Extend geotextile for full width of trench bottom and up the trench wall to the top of the pipe zone, or base material for manholes and miscellaneous structures.
2. Anchor geotextile trench walls prior to placing trench stabilization or bedding material.
3. Provide 24-inch minimum overlap at joints.

3.05 TRENCH STABILIZATION MATERIAL INSTALLATION

A. Rebuild trench bottom with trench stabilization material.

B. Place material over full width of trench in 6-inch lifts to required grade, providing allowance for bedding thickness.

C. Compact each lift so as to provide a firm, unyielding support for the bedding material prior to placing succeeding lifts.

3.06 INSTALLING BURIED PIPING

A. Install pipe per Section 33 05 01, Conveyance Piping—General, and per the detailed piping specifications for the particular type of pipe, and per the following:

1. Handle pipe in such a manner as to avoid damage to the pipe. Do not drop or dump pipe into trenches under any circumstances.
2. Inspect each pipe and fitting before lowering the buried pipe or fitting into the trench. Inspect the interior and exterior protective coatings. Patch damaged areas in the field with material recommended by the protective coating manufacturer. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after installation.

3. Grade trench bottom to line and grade allowing for pipe thickness and bedding. Remove hard spots that would prevent a uniform bedding thickness. Place specified bedding thickness over full trench width. Grade and compact the top of bedding before pipelaying to provide firm, continuous, uniform support along full pipe length, and compact to the relative compaction specified. Before laying each section of the pipe, check the grade with a straightedge and correct any irregularities. Provide sand bags to support the pipeline before CLSM placement.
4. Excavate bell hole at each joint to permit proper assembly and inspection of entire joint. Fill areas excavated for joints with CLSM.
5. Line and Grade: Per Section 33 05 01, Conveyance Piping—General.
6. Backfill pipe zone with CLSM as specified herein. Where CLSM is not required for pipe zone material, place pipe zone material simultaneously on both sides of the pipe, in maximum 8-inch lifts, keeping the level of backfill the same on each side. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling.
7. Compact each lift to the relative compaction specified herein.
8. Push the backfill material carefully onto the backfill previously placed in the pipe zone. Do not permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe. Do not operate heavy equipment over the pipe until at least 3 feet of backfill has been placed and compacted over the pipe.
9. When the pipelaying is not in progress, including the noon hours, close the open ends of pipe. Do not allow trench water, animals, or foreign material to enter the pipe.
10. Remove and dispose of all water entering the trench during the process of pipelaying. Keep the trench dry until the pipelaying and jointing are completed.
11. To avoid jarring pipe off grade, after setting (surveying) pipe to grade, do not move shoring until after joint welding, coating and initial CLSM pipe zone set. After initial set, lift shoring panels to fill all shoring voids with CLSM and bring up backfill uniformly on both side of the pipe.

3.07 PLACEMENT OF CLSM

A. The aggregate, cement, and water shall be proportioned either by weight or by volume. The water content shall be sufficient to produce a fluid, workable mix that will flow and can be pumped without segregation of the aggregate while being placed. Prepare CLSM in accordance with ASTM C94.

B. Provide batching equipment to obtain the proper weights of soil, cement, water, and admixtures. All measuring devices should be sensitive to a 2 percent variation above or below the actual weights required. Volumetric batching may be used, provided the same accuracy required for weight batching is maintained.

C. Design and operate the mixers used for mixing the CLSM so that the CLSM as discharged from the mixer is uniform in composition and consistency throughout each batch.

D. Place the CLSM such that it flows easily into all open spaces and voids between the pipe and the excavated trench. In some cases, such as trenches on a slope, a stiffer mix may be required to prevent it from flowing down the trench. In this case, use vibration to be sure that the CLSM completely fills all open spaces and voids.

E. Lay the pipe on the sand bags and place the CLSM bedding as shown on Drawings. Bedding shall be placed under pipe from one side and vibrated, as necessary, so that it flows under the pipe until it appears on the other side. CLSM shall then be added to both sides of the pipe and vibrated until it completely fills the space between the pipe and the excavated trench bottom. This operation shall follow as closely behind pipelaying operations as possible. Place CLSM in such a way as to prevent uplift or buckling of the pipe. CLSM shall be deposited as nearly as practicable in its final position and must in no way disturb the pipe trench or cause foreign material to become mixed with the cement slurry. CLSM shall be deposited into the trench to fill the voids when the shoring is removed.

F. Do not place and compact pipe zone backfill around the pipe until the CLSM has reached the initial set. Place and maintain a 6-inch cover of moist backfill cover until additional backfill is placed. If the ambient temperature is 40 degrees F or less, an additional 6-inch cover of backfill shall be placed over the 6-inch moist backfill cover prior to the end of the working day.

G. Whenever freezing temperatures are imminent, maintain the CLSM at a temperature of not less than 50 degrees F for 7 days after placement. The temperature of the mix shall be 50 degrees F or greater at the time of placement. The temperature shall be monitored by placing a thermometer in the CLSM immediately after sampling at the placement site. When freezing weather appear imminent, make ready at the placement site materials which may be required for protection of CLSM. Placement of CLSM shall be delayed until adequate provisions for protection against weather are made. No CLSM bedding shall be placed in pipe trenches when the trench bottom or walls are frozen or contain frozen material. Backfill placed as cover over the CLSM is prohibited from containing any frozen material.

3.08 GRANULAR PIPE BEDDING

A. Where CLSM is not required, furnish imported or processed excavated bedding material.

B. Place over full width of prepared trench bottom in two equal lifts when required depth exceeds 8 inches.

C. Hand grade and compact each lift to provide a firm, unyielding surface.

D. Minimum Thickness: As shown on Drawing.

E. Check grade and correct irregularities in bedding material. Loosen top 1 inch to 2 inches of compacted bedding material with a rake or by other means to provide a cushion before laying each section of pipe, conduit, direct-buried cable, or duct bank.

F. Install to form continuous and uniform support except at bell holes, if applicable, or minor disturbances resulting from removal of lifting tackle.

G. Bell or Coupling Holes: Excavate in bedding at each joint to permit proper assembly and inspection of joint and to provide uniform bearing along barrel of pipe or conduit.

3.09 GRANULAR BACKFILL PIPE ZONE

A. Where CLSM is not required, backfill with granular pipe zone material.

B. Restrain pipe, conduit, cables, and duct banks as necessary to prevent their movement during backfill operations.

C. Place material simultaneously in lifts on both sides of pipe and, if applicable, between pipes, conduit, cables, and duct banks installed in same trench.

1. Pipe 10-Inch and Smaller Diameter: First lift less than or equal to 1/2 pipe diameter.
2. Pipe Over 10-Inch Diameter: Maximum 6-inch lifts.

D. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by “walking in” and slicing material under haunches with a shovel to ensure voids are completely filled before placing each succeeding lift.

E. Compact material placed within 12 inches of the outer surface of the pipe by hand operated tampers or other equipment that will not damage the pipe.

3.10 MARKING TAPE INSTALLATION

A. Continuously install marking tape along centerline of buried piping, on top of last lift of pipe zone material. Coordinate with piping installation drawings.

1. Detectable Marking Tape: Install with nonmetallic piping and waterlines.
2. Nondetectable Marking Tape: Install with metallic piping.

3.11 TRACER WIRE INSTALLATION AND TESTING

A. Install tracer wire continuously along centerline of nonmetallic buried piping.

B. Attach wire to top of pipe using tape at maximum of 10-foot intervals. In areas where depth of cover is excessive for allowing detection of tracer wire with electronic pipe locator, install tracer wire within pipe backfill directly above pipe centerline.

C. Install splices in accordance with manufacturer’s instructions for direct bury applications. Tie ends of wire to be joined in a knot as required to reduce tension on splice.

D. Bring tracer wire to surface at each valve box, curb box, vault, air valve, blowoff valve, hydrant, and pipeline marker. Tracer wire shall be brought to surface at least every 1,000 feet. If distance between pipe appurtenances exceeds 1,000 feet, install valve box to allow access to tracer wire. Mark valve box cover with the word “TRACER.” Coil enough excess tracer wire at each appurtenance to extend wire 12 inches above ground.

E. Test continuity of tracer wire using electronic pipe locator in presence of Engineer prior to paving.

3.12 TRENCH BACKFILL ABOVE PIPE ZONE

A. General:

1. Process excavated material to meet specified gradation requirements.
2. Adjust moisture content as necessary to obtain specified compaction.
3. Do not allow backfill to free fall into trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over top of pipe.
4. Do not use power driven impact type compactors for compaction until at least 4 feet of backfill is placed over top of pipe.
5. Backfill to grade with proper allowances for topsoil, crushed rock surfacing, and pavement thicknesses, wherever applicable.

6. Backfill around structures with same class backfill as specified for adjacent trench, unless otherwise shown or specified.
7. No ponding or jetting allowed.
8. Do not place backfill on CLSM until it has gained sufficient strength in accordance with the requirements specified herein.

3.13 REPLACEMENT OF TOPSOIL

A. Replace topsoil in top 12 inches of backfilled trench.

B. Maintain finished grade of topsoil even with adjacent area and grade as necessary to restore drainage.

3.14 MAINTENANCE OF TRENCH BACKFILL

A. After each section of trench is backfilled, maintain surface of backfilled trench even with adjacent ground surface until final surface restoration is completed.

B. Gravel Surfacing Rock: Add gravel surfacing rock where applicable and as necessary to keep surface of backfilled trench even with adjacent ground surface, and grade and compact as necessary to keep surface of backfilled trenches smooth, free from ruts and potholes, and suitable for normal traffic flow.

C. Topsoil: Add topsoil where applicable and as necessary to maintain surface of backfilled trench level with adjacent ground surface.

D. Concrete Pavement: Replace settled slabs as specified in Section 32 12 16, Asphalt Paving.

E. Asphaltic Pavement: Replace settled areas or fill with asphalt as specified in Section 32 12 16, Asphalt Paving.

F. Other Areas: Add excavated material where applicable and keep surface of backfilled trench level with adjacent ground surface.

3.15 SETTLEMENT OF BACKFILL

A. Settlement of trench backfill, or of fill, or facilities constructed over trench backfill will be considered a result of defective compaction of trench backfill.

END OF SECTION

SECTION 31 32 19.16
GEOTEXTILE

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. ASTM International (ASTM):
   a. D737, Standard Test Method for Air Permeability of Textile Fabrics.
   b. D4355, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
   c. D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
   d. D4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
   e. D4595, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
   f. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
   g. D4716, Test Method for Determining the (In-Plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
   h. D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
   i. D4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
   j. D4884, Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Geotextiles.
   k. D4886, Standard Test Method for Abrasion Resistance of Geotextiles (Sand Paper/Sliding Block Method).
   l. D5199, Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.
   m. D5261, Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
   n. D6193, Standard Practice for Stitches and Seams.

1.02 DEFINITIONS

A. Fabric: Geotextile, a permeable geosynthetic comprised solely of textiles.

B. Maximum Average Roll Value (MaxARV): Maximum of series of average roll values representative of geotextile furnished.

C. Minimum Average Roll Value (MinARV): Minimum of series of average roll values representative of geotextile furnished.

D. Nondestructive Sample: Sample representative of finished Work, prepared for testing without destruction of Work.

E. Overlap: Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.

F. Seam Efficiency: Ratio of tensile strength across seam to strength of intact geotextile, when tested according to ASTM D4884.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Manufacturer material specifications and product literature.
   b. Installation drawings showing geotextile sheet layout, location of seams, direction of overlap, and sewn seams.
   c. Description of proposed method of geotextile deployment, sewing equipment, sewing methods, and provisions for holding geotextile temporarily in place until permanently secured.
2. Samples:
   a. Geotextile: One-piece, minimum 18 inches long, taken across full width of roll of each type and weight of geotextile furnished for Project. Label each with brand name and furnish documentation of lot and roll number from which each Sample was obtained.
   b. Field Sewn Seam: 5-foot length of seam, 12 inches wide with seam along center, for each type and weight of geotextile.
   c. Securing Pin and Washer: One each.

B. Informational Submittals:

1. Certifications from each geotextile manufacturer that furnished products have specified property values. Certified property values shall be either minimum or maximum average roll values, as appropriate, for geotextiles furnished.
2. Field seam efficiency test results.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver each roll with sufficient information attached to identify it for inventory and quality control.

B. Handle products in manner that maintains undamaged condition.

C. Do not store products directly on ground. Ship and store geotextile with suitable wrapping for protection against moisture and ultraviolet exposure. Store geotextile in way that protects it from elements. If stored outdoors, elevate and protect geotextile with waterproof cover.

1.05 SCHEDULING AND SEQUENCING

A. Where geotextile is to be laid directly upon ground surface, prepare subgrade as specified in Section 31 23 13, Subgrade Preparation, first.

B. Notify Engineer whenever geotextiles are to be placed. Do not place geotextile without Engineer's approval of underlying materials.

PART 2 PRODUCTS

2.01 WOVEN GEOTEXTILE

A. Composed of polymeric yarn interlaced to form planar structure with uniform weave pattern.

B. Calendared or finished so yarns will retain their relative position with respect to each other.

C. Polymeric Yarn: Long-chain synthetic polymers (polyester or polypropylene) with stabilizers or inhibitors added to make filaments resistant to deterioration due to heat and ultraviolet light exposure.

D. Sheet Edges: Selvaged or finished to prevent outer material from separating from sheet.

E. Unseamed Sheet Width: Minimum 6 feet.

F. Nominal Weight per Square Yard: 4 ounce per ASTM D5261.

G. Physical Properties: Conform to requirements in Table No. 1.

Table No. 1
Physical Property Requirements for Woven Geotextile

Property	Requirement	Test Method
Apparent Opening Size (AOS)	#50 - #70 U.S. Standard Sieve Size	ASTM D4751
Grab Tensile Strength	160 lb, MinARV	ASTM D4632
Grab Elongation	25 percent, MaxARV	ASTM D4632
Ultraviolet Radiation Resistance	70 percent strength retention, MinARV after 500 hours	ASTM D4355

2.02 NONWOVEN GEOTEXTILE

A. Pervious sheet of polyester, polypropylene, or polyethylene fabricated into stable network of fibers that retain their relative position with respect to each other. Nonwoven geotextile shall be composed of continuous or discontinuous (staple) fibers held together through needle-punching, spun-bonding, thermal-bonding, or resin-bonding.

B. Geotextile Edges: Selvaged or otherwise finished to prevent outer material from pulling away from geotextile.

C. Unseamed Sheet Width: Minimum 12 feet.

D. Nominal Weight per Square Yard: 16 ounce per ASTM D5261.

E. Physical Properties: Conform to requirements in Table No. 2.

Table No. 2
Physical Property Requirements for Nonwoven Geotextile

Property	Requirement	Test Method
Apparent Opening Size (AOS)	#100 U.S. Standard Sieve Size	ASTM D4751
Grab Tensile Strength, Machine Direction	300 lb/in, MinARV	ASTM D4632
Grab Elongation, Machine Direction	50 percent, MaxARV	ASTM D4632
Puncture Strength	190 lb, MinARV	ASTM D4833

Table No. 2 Physical Property Requirements for Nonwoven Geotextile		
Property	**Requirement**	**Test Method**
Trapezoid Tear Strength	115 lb, MinARV	ASTM D4533
Ultraviolet Radiation Resistance	70 percent strength retention, MinARV after 500 hours	ASTM D4355

2.03 SEWING THREAD

A. Polypropylene, polyester, or Kevlar thread.

B. Durability: Equal to or greater than durability of geotextile sewn.

2.04 SECURING PINS

A. Steel Rods or Bars:

1. 3/16-inch diameter.
2. Pointed at one end.
3. With head on other end sufficiently large to retain washer.
4. Minimum Length: 12 inches.

B. Steel Washers for Securing Pins:

1. Outside Diameter: Not less than 1.5 inches.
2. Inside Diameter: 1/4 inch.
3. Thickness: 1/8 inch.

C. Steel Wire Staples:

1. U-shaped.
2. 10 gauge.
3. Minimum Length: 6 inches.

PART 3 EXECUTION

3.01 LAYING GEOTEXTILE

A. Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.

3.02 SHEET ORIENTATION ON SLOPES

A. Orient geotextile with long dimension of each sheet parallel to direction of slope.

3.03 JOINTS

A. Unseamed Joints:

1. Overlapped.
2. Overlap, unless otherwise shown:
    a. Foundation/Subgrade Stabilization: Minimum 18 inches.
    b. Riprap: Minimum 18 inches.
    c. Drain Trenches: Minimum 18 inches, except overlap shall equal trench width if trench width is less than 18 inches.
    d. Other Applications: Minimum 12 inches.

B. Sewn Seams: Made wherever stress transfer from one geotextile sheet to another is necessary. Sewn seams, as approved by Engineer, also may be used instead of overlap at joints for applications that do not require stress transfer.

1. Seam Efficiency:
    a. Minimum 70 percent.
    b. Verified by preparing and testing minimum of one set of nondestructive Samples per acre of each type and weight of geotextile installed.
    c. Tested according to ASTM D4884.
2. Types:
    a. Preferred: “J” type seams.
    b. Acceptable: Flat or butterfly seams.
3. Stitch Count: Minimum three to maximum seven stitches per inch.
4. Stitch Type: Double-thread chainstitch according to ASTM D6193.
5. Sewing Machines: Capable of penetrating four layers of geotextile.
6. Stitch Location: 2 inches from geotextile sheet edges, or more, if necessary to develop required seam strength.

3.04 SECURING GEOTEXTILE

A. Secure geotextile during installation as necessary with sandbags or other means approved by Engineer.

B. Secure Geotextile with Securing Pins or Staples:

1. Insert securing pins with washers through geotextile.
2. Securing Pin Alignment:
   a. Midway between edges of overlaps.
   b. 6 inches from free edges.
3. Spacing of Securing Pins:

Slope	Maximum Pin Spacing
Steeper than 3:1	2 feet
3:1 to 4:1	3 feet
Flatter than 4:1	5 feet

4. Install additional pins across each geotextile sheet as necessary to prevent slippage of geotextile or to prevent wind from blowing geotextile out of position.
5. Push each securing pin through geotextile until washer bears against geotextile and secures it firmly to subgrade.
6. Where staples are used instead of securing pins, install in accordance with alignment and spacing above. Push in to secure geotextile firmly to subgrade.

3.05 PLACING PRODUCTS OVER GEOTEXTILE

A. Before placing material over geotextile, notify Engineer. Do not cover installed geotextile until after Engineer provides authorization to proceed.

B. If tears, punctures, or other geotextile damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geotextile. Repair damage as specified in Article Repairing Geotextile.

3.06 INSTALLING GEOTEXTILE IN TRENCHES

A. Place geotextile in a way to completely envelope granular drain material to be placed in trench and with specified overlap at joints. Overlap geotextile in direction of flow. Place geotextile in a way and with sufficient slack for geotextile to contact trench bottom and sides fully when trench is backfilled.

B. After granular drain material is placed to required grade, fold geotextile over top of granular drain material, unless otherwise shown. Maintain overlap until overlying fill or backfill is placed.

3.07 RIPRAP APPLICATIONS

A. Overlap geotextile at each joint with upstream sheet of geotextile overlapping downstream sheet.

B. Sew joints where wave run-up may occur.

C. Limit height of riprap fall onto geotextile to prevent damage.

3.08 SILT FENCE APPLICATIONS

A. Install geotextile in one piece, or continuously sewn to make one piece, for full length and height of fence, including portion of geotextile buried in toe trench.

B. Install bottom edge of sheet in toe trench and backfill in a way that securely anchors geotextile in trench.

C. Securely fasten geotextile to each support post in a way that will not result in tearing of geotextile when fence is subjected to service loads.

D. Promptly repair or replace silt fence that becomes damaged.

3.09 REPAIRING GEOTEXTILE

A. Repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile.

B. Repair Procedure:

1. Place patch of undamaged geotextile over damaged area and at least 18 inches in all directions beyond damaged area.
2. Remove interfering material as necessary to expose damaged geotextile for repair.
3. Sew patches or secure them with heat fusion tacking or with pins and washers, as specified above in Article Securing Geotextile, or by other means approved by Engineer.

3.10 REPLACING CONTAMINATED GEOTEXTILE

A. Protect geotextile from contamination that would interfere, in Engineer's opinion, with its intended function. Remove and replace contaminated geotextile with clean geotextile.

END OF SECTION

SECTION 31 41 00
SHORING

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Excavation support plan.
2. Movement monitoring plan.
3. Trench excavation plan.
4. Movement measurement and data and reduced results indicating movement trends.

1.02 QUALITY ASSURANCE

A. Provide surveys to monitor movements of critical facilities.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Design, provide, and maintain shoring, sheeting, and bracing as necessary to support the sides of excavations and to prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed the Work.

B. Where specifically shown on Drawings, provide sheeting, shoring, and bracing of trench excavations. Elsewhere sheeting, shoring, and bracing of excavations shall be used as necessary to protect existing utilities and structures, to maintain traffic, and to stay within the work limits. Existing facilities damaged as a result of construction shall be replaced by the Contractor at no additional cost to the Owner.

3.02 TRENCH EXCAVATION PLAN

A. Prepare trench excavation plan addressing following topics:

1. Details of shoring, bracing, sloping, or other provisions for worker protection from hazards of caving ground.
2. Design assumptions and calculations.
3. Methods and sequencing of installing excavation support.
4. Proposed locations of stockpiled excavated material.

5. Minimum lateral distance from the crest of slopes for vehicles and stockpiled excavated materials.
6. Anticipated difficulties and proposed resolutions.

B. Prevent potentially unsafe trench walls outside shoring. Fill all voids between shoring and excavated trench the same day shoring is installed. Fill voids in pipe zone with CLSM during removal of shoring system.

C. Address ground settlement and utility shearing/settlement during installation and removal of shoring. If shoring methods are damaging utilities or services, change shoring methods or provide alternate construction methods so utilities and services are in acceptable and functional condition during and after construction.

3.03 REMOVAL OF EXCAVATION SUPPORT

A. Remove excavation support in a manner that will maintain support as excavation is backfilled.

B. Do not begin to remove excavation support until support can be removed without damage to existing facilities, completed Work, or adjacent property.

C. Remove excavation support in a manner that does not leave voids in the backfill. Backfill all voids left by the shoring system.

3.04 TRENCHES

A. For trench excavation exceeding 5 feet in depth, provide adequate safety system meeting requirements of applicable state and local construction safety orders, and federal requirements.

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO):
   a. T11, Standard Method of Test for Materials Finer Than 75µm (No. 200) Sieve in Mineral Aggregates by Washing.
   b. T27, Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates.
   c. T89, Standard Specification for Determining the Liquid Limit of Soils.
   d. T90, Standard Specification for Determining the Plastic Limit and Plasticity Index of Soils.
   e. T96, Standard Specification for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
   f. T99, Standard Specification for the Moisture-Density Relations of Soils Using a 2.5 kg (5.5 pound) Rammer and a 305 mm (12 in) Drop.
   g. T180, Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18-in) Drop.
   h. T190, Standard Specification for Resistance R-Value and Expansion Pressure of Compacted Soils.
   i. T265, Standard Method of Test for Laboratory Determination of Moisture Content of Soils.
   j. T310, Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
2. ASTM International (ASTM):
   a. C88, Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
   b. D1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
   c. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   d. D1883, Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.

e. D2419, Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
f. D4791, Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
g. D6938, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.02 DEFINITIONS

A. Completed Course: Compacted, unyielding, free from irregularities, with smooth, tight, even surface, true to grade, line, and cross-section.

B. Completed Lift: Compacted with uniform cross-section thickness.

C. Standard Specifications: When referenced in this section, shall mean current version of the Utah Department of Transportation (UDOT) Standard Specifications for Road and Bridge Construction.

1.03 SUBMITTALS

A. Action Submittals:

1. Samples: Submit for specified materials 30 days prior to delivery to Site.

B. Informational Submittals:

1. Certified Test Results on Source Materials: Submit copies from commercial testing laboratory 30 days prior to delivery of materials to Project showing materials meeting the physical qualities specified.
2. Certified results of in-place density tests from independent testing agency.

PART 2 PRODUCTS

2.01 AGGREGATE BASE COURSE (UNTREATED BASE COURSE)

A. Aggregate for base courses shall meet the requirements for 1-1/2-inch gradation per UDOT Section 02721, Untreated Base Course, of the most recent UDOT Standard Specifications.

2.02 SOURCE QUALITY CONTROL

A. Perform tests necessary to locate acceptable source of materials meeting specified requirements.

B. Final approval of aggregate material will be based on test results of installed materials.

C. Should separation of coarse from fine materials occur during processing or stockpiling, immediately change methods of handling materials to correct uniformity in grading.

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

A. As specified in Section 31 23 13, Subgrade Preparation.

B. Obtain Engineer's acceptance of subgrade before placing base course or surfacing material.

C. Do not place base course or surfacing materials in snow or on soft, muddy, or frozen subgrade.

3.02 EQUIPMENT

A. Compaction Equipment: Adequate in design and number to provide compaction and to obtain specified density for each layer.

3.03 HAULING AND SPREADING

A. Hauling Materials:

1. Do not haul over surfacing in process of construction.
2. Loads: Of uniform capacity.
3. Maintain consistent gradation of material delivered; loads of widely varying gradations will be cause for rejection.

B. Spreading Materials:

1. Distribute material to provide required density, depth, grade, and dimensions with allowance for subsequent lifts.
2. Produce even distribution of material upon roadway or prepared surface without segregation.
3. Should segregation of coarse from fine materials occur during placing, immediately change methods of handling materials to correct uniformity in grading.

3.04 CONSTRUCTION OF COURSES

A. Untreated Aggregate Base Course:

1. Maximum Completed Lift Thickness: 6 inches.
2. Completed Course Total Thickness: As shown on Drawings.
3. Spread lift on preceding course to required cross-section.
4. Lightly blade and roll surface until thoroughly compacted.
5. Add keystone to achieve compaction and as required when aggregate does not compact readily due to lack of fines or natural cementing properties, as follows:
   a. Use leveling course or surfacing material as keystone.
   b. Spread evenly on top of base course, using spreader boxes or chip spreaders.
   c. Roll surface until keystone is worked into interstices of base course without excessive displacement.
   d. Continue operation until course has become thoroughly keyed, compacted, and will not creep or move under roller.
6. Blade or broom surface to maintain true line, grade, and cross-section.

3.05 ROLLING AND COMPACTION

A. Commence compaction of each layer of base after spreading operations and continue until density of 95 percent of maximum density has been achieved as determined by ASTM D1557.

B. Commence rolling at outer edges and continue toward center; do not roll center of road first.

C. Apply water as needed to obtain specified densities.

D. Place and compact each lift to required density before succeeding lift is placed.

E. Surface Defects: Remedy by loosening and rerolling. Reroll entire area, including surrounding surface, until thoroughly compacted.

F. Finished surface shall be true to grade and crown before proceeding with surfacing.

3.06 SURFACE TOLERANCES

A. Blade or otherwise work surfacing as necessary to maintain grade and cross-section at all times, and to keep surface smooth and thoroughly compacted.

B. Finished Surface of Untreated Aggregate Base Course: Within plus or minus 0.04 foot of grade shown at any individual point.

3.07 FIELD QUALITY CONTROL

A. In-Place Density Tests: As specified in Section 31 23 23, Fill and Backfill.

3.08 CLEANING

A. Remove excess material from the Work area. Clean stockpile and staging areas of all excess aggregate.

END OF SECTION

SECTION 32 12 16
ASPHALT PAVING

PART 1 GENERAL

1.01 DESCRIPTION

A. This section includes materials, testing, and installation of asphalt concrete pavement, tack coat, and other required incidentals for asphalt concrete paving.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 50 00, Temporary Facilities and Controls.

B. Section 01 51 00, Permits.

C. Section 31 23 13, Subgrade Preparation.

D. Section 31 23 23, Fill and Backfill.

E. Section 31 23 23.15, Trench Backfill.

F. Section 32 11 23, Aggregate Base Courses.

G. Section 32 17 23, Pavement Markings.

H. UDOT Standard Specifications for Road and Bridge Construction where applicable.

1.03 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO):
   a. M17, Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
   b. M82, Standard Specification for Cut-Back Asphalt (Medium Curing Type).
   c. M140, Standard Specification for Emulsified Asphalt.
   d. M208, Standard Specification for Cationic Emulsified Asphalt.
   e. M320, Standard Specification for Performance Graded Asphalt Binder.

f. T166, Standard Method of Test for Bulk Specific Gravity of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens.
g. T176 Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test.
h. T230, Standard Method of Test for Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures.
i. T245, Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
j. T246, Standard Method of Test for Resistance to Deformation and Cohesion of Bituminous Mixtures by Means of Hveem Apparatus.
k. T247, Standard Method of Test for Preparation of Test Specimens of Bituminous Mixtures by Means of California Kneading Compactor.
l. T283, Standard Method of Test for Resistance of Compacted Bituminous Mixture to Moisture Induced Damage.
m. T304, Standard Method of Test for Uncompacted Void Content of Fine Aggregate (Method A).

2. Asphalt Institute (AI):
   a. Manual Series No. 2 (MS-2), Mix Design Methods for Asphalt Concrete.
   b. Superpave Series No. 2 (SP-2), Superpave Mix Design.
3. ASTM International (ASTM):
   a. D2041, Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.
   b. D2170, Standard Test Method for Kinematie Viscosity of Asphalts (Bitumens).
   c. D2950, Standard Test Method for Density of Bituminous Concrete in place by Nuclear Methods.
   d. D4318, Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
   e. D4791, Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
   f. D5821, Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.
   g. E329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
4. Utah Department of Transportation (UDOT): Standard Specifications for Road and Bridge Construction.

1.04 DEFINITIONS

A. Combined Aggregate: All mineral constituents of asphalt concrete mix, including mineral filler and separately sized aggregates.

B. RAP: Reclaimed asphalt pavement.

C. Standard Specifications: When referenced in this section, shall mean Utah Department of Transportation (UDOT) Standard Specifications for Road and Bridge Construction, most recent edition.

D. ESALs: 18,000-pound equivalent single axle load.

1.05 DESIGN REQUIREMENTS

A. Prepare Asphalt Concrete Mix Design in accordance with Section 02741 of the (UDOT) Standard Specifications.

1. Asphalt cement shall be PG 58/28 or “or-equal.”
2. No more than 15 percent of RAP is allowed.
3. Aggregate shall be 1/2-inch.

1.06 SUBMITTALS

A. Informational Submittals as specified in Section 02741 of the (UDOT) Standard Specifications.

1.07 ACCEPTANCE

A. Acceptance shall be as specified in Section 02741 of the (UDOT) Standard Specifications.

PART 2 PRODUCTS

2.01 PRODUCTS

A. All products shall be as specified in Section 02741 of the (UDOT) Standard Specifications.

PART 3 EXECUTION

3.01 GENERAL

A. Traffic Control: Minimize inconvenience to traffic but keep vehicles off freshly treated or paved surfaces to avoid pickup and tracking of asphalt.

3.02 PREPARATION

A. Prepare subgrade as shown on Drawings and as in Section 31 23 13, Subgrade Preparation.

B. Existing Roadway:

1. Remove cracked pavement within 10 feet of either side of the trench and all Contractor-damaged pavement regardless of distance from the trench.
2. Sawcut at meet lines.
3. Paint edges of meet line with tack coat prior to placing new pavement.

C. Thoroughly coat edges of contact surfaces (curbs, manhole frames) with emulsified asphalt or asphalt cement prior to laying new pavement. Prevent staining of adjacent surfaces.

3.03 APPLICATION

A. General: Place asphalt concrete paving as specified in Section 02741 of the (UDOT) Standard Specifications.

3.04 PAVEMENT MARKING

A. Conform to Section 32 17 23, Pavement Markings.

3.05 FIELD QUALITY CONTROL

A. As specified in Section 02741 of the (UDOT) Standard Specifications.

END OF SECTION

SECTION 32 17 23
PAVEMENT MARKINGS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO):
   a. M237, Standard Specification for Epoxy Resin Adhesives for Bonding Traffic Markers to Hardened Portland Cement and Asphalt Concrete.
   b. M247, Standard Specification for Glass Beads Used in Traffic Paint.
   c. M248, Standard Specification for Ready-Mixed White and Yellow Traffic Paints.
   d. M249, Standard Specification for White and Yellow Reflective Thermoplastic Striping Material (Solid Form).
2. ASTM International (ASTM): D4280, Standard Specification Extended Life Type, Nonplowable, Prismatic, Raised, Retroreflective Pavement Markers.
3. Federal Specifications (FS):
   a. A-A-2886A, Paint, Traffic, Solvent Based.
   b. TT-B-1325C, Beads (Glass Spheres); Retroreflective.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Product Data:
      1) Paint.
      2) Thermoplastic material.
      3) Reflective markers.
      4) Epoxies, resins, and primers to be used.
   b. Glass Beads: Proposed gradation.

B. Informational Submittals:

1. Description of proposed methods for removal of drips, overspray, improper markings, paint and thermoplastic material tracked by traffic, and existing markings.

2. Manufacturer's Certificate of Compliance, in accordance with products specified in this section.
3. Equipment List: Proposed equipment to be used, including descriptive data.
4. Manufacturer's Instructions:
    a. Application of preformed tape.
    b. Application of Portland cement concrete primer.
    c. Application of glass beads.
    d. Application of epoxy resin.
    e. Installation of reflective markers.

PART 2 PRODUCTS

2.01 PAINT

A. Color: White or yellow.

B. Traffic paint in accordance with UDOT Specifications.

C. Homogeneous, easily stirred to smooth consistency, with no hard settlement or other objectionable characteristics during storage period of 6 months.

2.02 THERMOPLASTIC MARKING

A. Color: White or yellow.

2.03 RAISED REFLECTIVE MARKERS

A. Metallic or nonmetallic, or prismatic reflector type, of permanent colors retaining color and brightness under action of traffic.

B. Rounded surfaces presenting a smooth contour to traffic.

C. Color: Yellow.

D. Marker in accordance with ASTM D4280.

E. Epoxy in accordance with AASHTO M237.

PART 3 EXECUTION

3.01 GENERAL

A. Surface Preparation, Application, and Protection: In accordance with the Standard Specifications.

3.02 SURFACE PREPARATION

A. Cleaning:

1. Thoroughly clean surfaces to be marked before application of pavement marking material.
2. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water or a combination of these methods.
3. Completely remove rubber deposits, surface laitance, existing paint markings, and other coatings adhering to pavement with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion.
4. Scrub areas of old pavement affected with oil or grease with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application.
5. Surfaces shall be completely free of dirt and ice, and dry of water at the time of application of materials specified herein.
6. Oil-Soaked Areas: After cleaning, seal with cut shellac to prevent bleeding through the new paint.
7. Reclean surfaces when the Work has been stopped due to rain.
8. Existing Pavement Markings:
    a. Remove existing pavement markings that may interfere or conflict with newly applied marking patterns, or that may result in a misleading or confusing traffic pattern.
    b. Do not apply thermoplastic markings over existing preformed or thermoplastic markings.
    c. Perform grinding, scraping, sandblasting or other operations so finished pavement surface is not damaged.

B. Pretreatment for Early Painting: Where painting is required prior to 30 days after paving rigid pavements, pretreat with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride.

C. New Concrete Pavement:

1. Allow a minimum cure time of 30 days before cleaning and marking.
2. Clean by either sandblasting or water blasting to the following results:
    a. No visible evidence of curing compound on peaks of textured concrete surface.
    b. No heavy puddled deposits of curing compound in valleys of textured concrete surface.
    c. Remaining curing compound is intact, with loose and flaking material completely removed.
    d. Peaks of textured pavement surface are rounded in profile and free of sharp edges and irregularities.

3. Allow a minimum drying time of 24 hours after water blasting before applying thermoplastic markings.

D. New Asphalt Pavement: Allow a minimum pavement cure time of 30 days before applying paint.

3.03 PAINT APPLICATION

A. General:

1. Thoroughly mix pigment and vehicle together prior to application, and keep thoroughly agitated during application.
2. Do not add thinner.
3. Apply only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Maintain paint temperature within these same limits.
4. Apply only when surface is dry.
5. Do not apply when conditions are windy to the point of causing overspray or fuzzy line edges.
6. Provide guidelines and templates to control paint application.
7. Take special precautions in marking numbers, letters, and symbols.
8. Sharply outline edges of markings and apply without running or spattering.

B. Rate of Application:

1. Reflective Markings: Apply evenly, 105 plus or minus 5 square feet per gallon.
2. Glass Bead Application:
   a. Apply immediately following application of paint.
   b. Use evenly distributed drop-on application method.
   c. Rate: 6 pounds per gallon of paint.
3. Nonreflective Markings: Apply paint evenly to pavement surface at a rate of 105 plus or minus 5 square feet per gallon.
4. On new pavement or new asphalt surface treatments, apply two coats of paint at a uniform rate of 210 square feet per gallon.

C. Drying:

1. Provide maximum drying time to prevent undue softening of bitumen and pickup, displacement, or discoloration by traffic.
2. If drying is abnormally slow, discontinue painting operations until cause is determined and corrected.

D. Protection:

1. Protect markings from traffic until paint is thoroughly dry.
2. Protect surfaces from disfiguration by paint spatters, splashes, spills, or drips.

E. Cleanup: Remove paint spatters, splashes, spills, or drips from the Work and staging areas including areas outside the immediate Work area where spills occur.

3.04 THERMOPLASTIC MARKING APPLICATION

A. Following specified surface preparation, prime and apply marking and glass beads to provide a reflectorized strip as shown on Drawings.

B. Application Temperatures:

1. Pavement Surface: Minimum 40 degrees F and rising.
2. Thermoplastic: Minimum 375 degrees F, maximum 425 degrees F.

C. Primer:

1. On Portland cement concrete and existing asphalt pavements, apply epoxy resin primer/sealer according to thermoplastic manufacturer's recommendations.
2. All primer/sealer to dry prior to applying thermoplastic.

D. Thermoplastic Marking:

1. Extrude or spray in a molten state, free of dirt or tint at a minimum thickness of 0.125 inch.
2. Apply centerline, skipline, edgeline, and other longitudinal type markings with a mobile applicator.
3. Apply special markings, crosswalks, stop bars, legends, arrows, and similar patterns with a portable, extrusion-type applicator.

E. Glass Bead Application:

1. Immediately after marker application, mechanically apply such that the beads are held by and imbedded in the surface of the molten material.
2. Application Rate: 1 pound per 20 square feet of compound.

F. Cool completed marking to ambient temperature prior to allowing vehicular traffic.

3.05 INSTALLATION OF RAISED REFLECTIVE MARKERS

A. Apply epoxy to cleaned and prepared pavement area per manufacturer's instructions.

B. Apply marker to epoxy before epoxy has a chance to set.

C. Align markers carefully, projecting no more than 3/4 inch above level of pavement.

D. Spacing:

1. Solid Longitudinal Lines: Match existing per South Jordan Standards.
2. Broken Centerlines: Match existing per South Jordan Standards.

END OF SECTION

SECTION 32 31 13
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A121, Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
   b. A313/A313M, Standard Specification for Stainless Steel Spring Wire.
   c. A392, Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
   d. A491, Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric.
   e. A497/A497M, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
   f. A615/A615M, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   g. A780, Standard Specification for Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings.
   h. A824, Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use with Chain Link Fence.
   i. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
   j. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   k. C150, Standard Specification for Portland Cement.
   l. C387, Standard Specifications for Packaged, Dry, Combined Materials for Mortar and Concrete.
   m. F552, Standard Terminology Relating to Chain Link Fencing.
   n. F567, Standard Practice for Installation of Chain-Link Fence.
   o. F626, Standard Specification for Fence Fittings.
   p. F668, Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.
   q. F900, Standard Specification for Industrial and Commercial Swing Gates.
   r. F934, Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.
   s. F1043, Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.

t. F1083, Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
u. F1183, Standard Specifications for Aluminum Alloy Chain Link Fence Fabric.
v. F1184, Standard Specifications for Industrial and Commercial Horizontal Slide Gates.
w. F1379, Standard Terminology Relating to Barbed Tape.
x. F1911, Standard Practice for Installation of Barbed Tape.
y. F1916, Standard Specification for Selecting Chain Link Barrier Systems with Coated Chain Link Fence Fabric and Round Posts for Detention Applications.

2. Institute of Electrical and Electronic Engineers (IEEE), Inc.: C2, National Electrical Safety Code.
3. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 volts max.).

1.02 DEFINITIONS

A. Terms as defined in ASTM F552.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Product Data: Include construction details, material descriptions, dimensions of individual components, and finishes for chain link fences and gates.
      1) Fence, gate posts, rails, and fittings.
      2) Chain link fabric.
      3) Gates and hardware.
      4) Gate operators, motors, and mounting arrangements, switches, and controls; include operating instructions.
      5) Gate access system, including access control features, power and control wiring diagrams, and operating instructions.
      6) Accessories: Barbed wire.
2. Samples:
   a. Chain Link Fabric: Approximately 6 inches square.
   b. Posts, Rails, Braces, Wire, and Ties: Approximately 6 inches long.
   c. Fittings: One each.
3. Test Reports: Field test result for compliance of installation of chain link fence, gates, and gate operators.

B. Informational Submittals:

1. Manufacturer's recommended installation instructions.
2. Evidence of Supplier and installer qualifications.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Automatic Gate Operator System Supplier: 5 years' experience in gate operator systems.
2. Automatic Gate Operator System Installer: Experienced installer who has completed chain link fences and gates similar in material, design, and extent to those indicated for Project and whose work has resulted with a record of successful in-service performance with a minimum 3 years' experience.

B. Design, supply of equipment and components, installation, and on-call service shall be product of individual company with record of installations meeting requirements specified.

C. Preinstallation Conference: Conduct conference at project Site with gate installer to verify layout and operations of automatic gate operating system.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Site in undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

1.06 SCHEDULING AND SEQUENCING

A. Complete necessary Site preparation and grading before installing chain link fence and gates.

B. Interruption of Existing Utility Service: Notify owner of utility 72 hours prior to interruption of utility services. Do not proceed with interruption of utility service without written permission from utility owner.

PART 2 PRODUCTS

2.01 GENERAL

A. Match style, finish, and color of each fence component with that of other fence components.

2.02 CHAIN LINK FENCE FABRIC

A. Black vinyl chain link fabric conforming to ASTM F668, Class 1 or Class 2a.

B. Height: 72 inches unless noted otherwise.

C. Wire Gauge: 0.15-inch diameter.

D. Pattern: 2-inch diamond-mesh.

E. Diamond Count: Manufacturer’s standard and consistent for fabric furnished of same height.

F. Loops of Knuckled Selvages: Closed or nearly closed with space not exceeding diameter of wire.

G. Wires of Twisted Selvages:

1. Twisted in a closed helix three full turns.
2. Cut at an angle to provide sharp barbs that extend minimum 1/4-inch beyond twist.

2.03 POSTS

A. General:

1. Strength and Stiffness Requirements: ASTM F1043, Heavy Industrial Fence, except as modified in this section.
2. Steel Pipe: ASTM F1083.
3. Roll-Formed Steel Shapes: Roll-formed from ASTM A570, Grade 45, steel.
4. Lengths: Manufacturer's standard with allowance for minimum embedment below finished grade of 22 inches plus 3 inches for each 1 foot of fence height greater than 4 feet.
5. Zinc protective coating.

B. Line Posts:

1. Steel Pipe:
   a. Outside Diameter: 2-3/8 inches.
   b. Weight: 3.65 pounds per foot.

C. End, Corner, Angle, and Pull Posts:

1. Steel Pipe:
   a. Outside Diameter: 2-7/8 inches.
   b. Weight: 5.79 pounds per foot.

D. Posts for Removable Fence Panels: As specified for end, corner, angle, and pull posts.

E. Posts for Gates:

1. ASTM F900.
2. Roll-formed steel shapes may be substituted for steel pipe posts for gate leaf widths up to 6 feet and fabric heights up to 8 feet.
   a. Outside Dimensions: 4.5 inch diameter, schedule 40.
   b. Weight: 4.85 pounds per foot.

2.04 TOP AND BRACE RAILS

A. Galvanized steel pipe or roll-formed steel C shapes. Provide colored vinyl top-coating over posts, fabric and other chain link components, but only when colored fencing is specifically called for on Drawings.

B. Protective Coatings: As specified for posts.

C. Color Coating: Where called for on Drawings, provide a vinyl topcoat 10-mil minimum thickness over protective coating.

D. Strength and Stiffness Requirements: ASTM F1043, Top Rail, Heavy or Light Industrial Fence.

E. Steel Pipe:

1. ASTM F1083.
2. Outside Diameter: 1.66 inches.
3. Weight: 2.27 pounds per foot.

F. Roll-Formed Steel C Shapes:

1. Roll formed from ASTM A570, Grade 45.
2. Outside Dimensions: 1.625 inches by 1.25 inches.
3. Weight: 1.40 pounds per foot.

2.05 FENCE FITTINGS

A. General: In conformance with ASTM F626, except as modified by this Article.

B. Post and Line Caps: Designed to accommodate passage of top rail through cap, where top rail required.

C. Tension and Brace Bands: Vinyl-clad if colored fencing is called for on Drawings.

D. Tension Bars:

1. One-piece, vinyl clad.
2. Equal in length to full height of fabric.

E. Truss Rod Assembly: 3/8-inch diameter.

F. Barb Arms: 45-degree arms for supporting three strands of barbed wire.

2.06 TENSION WIRE

A. Zinc-coated steel marcelled tension wire conforming to ASTM A824, Type II, Class 2.

2.07 GATES

A. General:

1. Gate Operation: Opened and closed easily by one person.
2. Welded Steel Joints: Paint with zinc-based paint.
3. Chain Link Fabric: Attached securely to gate frame at intervals not exceeding 15 inches.

B. Gates Swing Gates: ASTM F900.

1. Hinges:
   a. Furnished with large bearing surfaces for clamping in position.
   b. Designed to swing either 180 degrees outward, 180 degrees inward, or 90 degrees in or out, as shown, and not twist or turn under action of gate.
2. Latches:
   a. Single leaf gates 10 feet wide or narrower: Provide forked latch which allows a padlock with a 1/4-inch diameter steel bar. Owner will provide padlock.
   b. Double leaf gates. Omit center plunger bar. Provide 2-foot long stainless steel chain (1/4-inch stainless steel link bar diameter, rated to 2,200 pounds. Owner will provide padlock.
3. Locking Device and Padlock Eyes: Integral part of latch on single leaf gates.
4. Hold-Open Keepers: Designed to automatically engage gate leaf and hold it in open position until manually released.

C. Cantilever and Overhead Horizontal Sliding Gates:

1. Comply with ASTM F1184 for single slide gate Types I and II, Class 1 with external roller assemblies.
2. Cantilever Gate Support Posts: Spaced on maximum 10 foot centers.
3. Roller Guards: As required per ASTM F1184 for Type II, Class 1 gate.
4. Hangers, roller assemblies, and stops fabricated from galvanized malleable iron.

2.08 CONCRETE

A. Provide as specified in Section 03 30 10, Structural Reinforced Concrete.

PART 3 EXECUTION

3.01 GENERAL

A. Install chain link fences and gates in accordance with ASTM F567, except as modified in this section, and in accordance with fence manufacturer's recommendations, as approved by Engineer. Erect fencing in straight lines between angle points.

B. Provide necessary hardware for a complete fence and gate installation.

C. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A780.

D. Drainage Crossings: Where the chain-link fence must cross drainage ditches or swales, the main fence shall be carried across a ditch or swale with additional fence added below.

1. Frames and Bracing: The fence added below shall be fabricated with galvanized round steel pipe conforming to the requirements for top and brace rails.
2. The construction of the frame shall be welded or assembled with corner fittings. The frame shall be rigid and to the extent necessary to maintain a 2-inch clearance between bottom of the frame and finish grade. If necessary to maintain rigidity, attach to the frame a series of 3/8-inch diameter galvanized steel pipe stakes that are embedded a minimum of 2 feet to the sides and bottom of the ditch.
3. Attach chain link fabric securely to frame at intervals not exceeding 12 inches.

3.02 PREPARATION

A. Clear area on either side of fence to the extent specified in Section 31 10 00, Site Clearing. Eliminate ground surface irregularities along fence line to the extent necessary to maintain a 2-inch clearance between bottom of fabric and finish grade.

B. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.03 POST SETTING

A. Drill or hand-excavate holes for posts to diameters and spacing indicated, in firm, undisturbed soil. Driven posts are not acceptable. Postholes shall be clear of loose materials. Waste materials from postholes shall be removed from Site or regraded into slopes on Site.

B. Posthole Depth:

1. Minimum 3 feet below finished grade.
2. 2 inches deeper than post embedment depth below finish grade.

C. Set posts with minimum embedment below finished grade of 34 inches and with top rail at proper height above finished grade. Verify posts are set plumb, aligned, and at correct height and spacing. Brace posts, as necessary, to maintain correct position and plumbness until concrete sets.

D. Backfill postholes with concrete to 2 inches above finished grade. Vibrate or tamp concrete for consolidation. Protect above ground portion of posts from concrete splatter.

E. Before concrete sets, crown and finish top of concrete to readily shed water.

F. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.

G. Line Posts: Space line posts uniformly at 10 feet on centers between terminal end, corner, and gate posts.

3.04 POST BRACING

A. Install according to ASTM F567, maintaining plumb position, and alignment of fencing. Install braces at gate, end, pull, and corner posts diagonally to adjacent line posts to ensure stability. Install braces on both sides of corner and pull posts. Locate diagonal braces on fences with top rail. Install so posts are plumb when diagonal truss rod assembly is under proper tension.

3.05 TOP RAILS

A. Install according to ASTM F567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps and terminating into rail end attached to posts or posts caps fabricated to receive rail at terminal posts. Install top rail sleeves with springs at 105 feet maximum spacing to permit expansion in rail.

3.06 TENSION WIRE

A. Install according to ASTM F567 and ASTM F1916, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with tie wires at a maximum spacing of 24 inches on center.

B. Install tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.

3.07 CHAIN LINK FABRIC

A. Do not install fabric until concrete has cured minimum 7 days.

B. Install fabric with twisted and barbed selvage at top.

C. Apply fabric to outside of enclosing framework. Pull fabric taut to provide a smooth and uniform appearance free from sag, without permanently distorting fabric diamond or reducing fabric height. Tie fabric to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

D. Splicing shall be accomplished according to ASTM F1916 by weaving a single picket into the ends of the rolls to be joined.

E. Leave 2 inches between finish grade or surface and bottom selvage, unless otherwise indicated.

F. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches on center.

G. Tie Wires: Fasten ties to wrap a full 360 degrees around rail or post and a minimum of one complete diamond of fabric. Twist ends of tie wire three full twists, and cut off protruding ends to preclude untwisting by hand.

1. Maximum Spacing: Tie fabric to line posts at 12 inches on center and to brace and top rails at 24 inches on center.

3.08 GATES

A. Install gates according to manufacturer's written instructions, level, plumb and secure for full opening without interference. Attach fabric and hardware to gate using tamper-resistant or concealed means. Adjust hardware for smooth operation and lubricate where necessary so gates operate satisfactorily from open or closed position.

B. Set gate stops in concrete to engage center drop rod or plunger bar.

3.09 FIELD QUALITY CONTROL

A. Post and Fabric Testing: Test fabric tension and line post rigidity according to ASTM F1916.

B. Gate Tests:

1. Prior to acceptance of installed gates, demonstrate proper operation of gates under each possible open and close condition specified.
2. Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range.
3. Confirm that latches and locks engage accurately and securely without forcing and binding.

3.10 CLEANUP

A. Remove excess fencing materials and other debris from Site.

END OF SECTION

SECTION 32 91 13
SOIL PREPARATION

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C33/C33M, Standard Specification for Concrete Aggregates.
   b. C602, Standard Specification for Agricultural Liming Materials.
   c. D2974, Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
   d. D5268, Standard Specification for Topsoil Used for Landscaping Purposes.

1.02 SUBMITTALS

A. Action Submittals:

1. Samples: Representative of stockpiled or imported topsoil.

B. Informational Submittals:

1. Certified Topsoil Analysis Reports:
   a. Indicate quantities of materials necessary to bring imported topsoil into compliance with textural/gradation requirements.
   b. Indicate quantity of lime, quantity and analysis of fertilizer, and quantity and type of soil additive.

1.03 SEQUENCING AND SCHEDULING

A. Rough grade areas to be planted or seeded. Perform Work specified in Section 31 10 00, Site Clearing, prior to performing Work specified under this section.

PART 2 PRODUCTS

2.01 TOPSOIL

A. General: Natural, friable, sandy loam, obtained from well-drained areas, free from objects larger than 1-1/2 inches maximum dimension, and free of subsoil, roots, grass, other foreign matter, hazardous or toxic substances, and deleterious material that may be harmful to plant growth or may hinder grading, planting, or maintenance.

B. Composition: In general accordance with ASTM D5268:

1. Gravel-Sized Fraction: Maximum 5 percent by weight retained on a No. 10 sieve.
2. Sand-Sized Fraction: Minimum 20 percent to 60 percent passing No. 10 sieve.
3. Silt and Clay-Sized Fraction: Minimum 35 percent to 70 percent.

C. Organic Matter: Minimum 1.5 percent by dry weight as determined in accordance with ASTM D2974.

D. pH: Range 5.0 to 7.0.

E. Textural Amendments: Amend as necessary to conform to required composition by incorporating sand, peat, manure, or sawdust.

F. Source: Stockpile salvaged topsoil material onsite, in accordance with Section 31 10 00, Site Clearing. Import topsoil if onsite material is insufficient in quantity.

2.02 SOIL ADDITIVES

A. Sawdust or Ground Bark:

1. Nontoxic, of uniform texture, and subject to slow decomposition when mixed with soil.
2. Nitrogen-treated, or if untreated mix with minimum 0.15 pound of ammonium nitrate or 0.25 pound of ammonium sulfate per cubic foot of loose material.

B. Peat:

1. Composition: Natural residue formed by decomposition of reeds, sedges, or mosses in a freshwater environment, free from lumps, roots, and stones.
    a. Organic Matter: Not less than 90 percent on a dry weight basis as determined by ASTM D2974.
    b. Moisture Content: Maximum 65 percent by weight at time of delivery.

C. Fertilizer:

1. Natural:
   a. Manure:
      1) Well-rotted, stable or cattle manure, free from weed seed and refuse.
      2) Maximum 50 percent sawdust or shavings by volume.
      3) Age: Minimum 4 months; maximum 2 years.

D. Sand:

1. Fine Aggregate: Clean, coarse, well-graded, ASTM C33/C33M.

2.03 SOIL STERILANT

A. Granular Calcium Cyanamide: Herbicide, manufactured by American Cyanamide Co.

2.04 SOURCE QUALITY CONTROL

A. Topsoil Analysis/Testing: Performed by county or state soil testing service or approved certified independent testing laboratory.

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

A. Scarify subgrade to minimum depth of 6 inches where topsoil is to be placed.

B. Remove stones over 2-1/2 inches in any dimension, sticks, roots, rubbish, and other extraneous material.

C. Limit preparation to areas which will receive topsoil within 2 days after preparation.

3.02 TOPSOIL PLACEMENT

A. Do not place topsoil when subsoil or topsoil is frozen, excessively wet, or otherwise detrimental to the Work.

B. Mix soil amendments, lime, and other soil additives, identified in analysis reports with topsoil before placement or spread on topsoil surface and mix thoroughly into entire depth of topsoil before planting or seeding. Delay mixing of fertilizer if planting or seeding will not occur within 3 days.

C. Place one-half of the total depth of topsoil and work into top 4 inches of subgrade soil to create a transition layer. Place remainder of topsoil to depth 12 inches where seeding and planting are scheduled.

D. Uniformly distribute to within 1 inch of final grades. Fine grade topsoil eliminating rough or low areas and maintaining levels, profiles, and contours of subgrade.

E. Remove stones exceeding 1-1/2-inch diameter, roots, sticks, debris, and foreign matter during and after topsoil placement.

F. Remove surplus subsoil and topsoil from Site. Grade stockpile area as necessary and place in condition acceptable for planting or seeding.

3.03 INSTALLATION OF EROSION CONTROL JUTE NETTING BLANKET

A. Apply erosion control blanket on all disturbed surface susceptible to erosion from wave action and on all disturbed slopes at 2.5H:1V and stepper, where seeding is required (i.e., cut and fill slopes, steep pipe construction area, etc.).

B. Complete all soil preparation and seeding in areas to receive erosion control blanket before placing blanket. Apply erosion control blanket within 5 calendar days after seeding and before precipitation falls. Install blanket per manufacturer's instructions with correct side up. Do not stretch the blanket. Allow it to loosely lie on the soil to achieve maximum soil contact. Horizontal seams within 15 feet of the top of the slope are not permitted. Do not tear or rip the blanket during installation.

C. Staple the blanket per manufacturer's specifications. Staple requirements vary according to steepness and length of slope. Place additional staple in areas such as swales, against rock outcroppings and as required to provide blanket to ground contact.

D. Deliver all seed to the Project Site unmixed and in sealed containers. Label all seed according to state and federal seed laws with each container bearing the seed suppliers tags indicating the container weight, seed type (genus and species), seed purity percent, seed germination percent and date seed tested. A sample of each seed type shall be drawn at the time of delivery to the Site by the Engineer. Samples will be tested to assure compliance with the seed specifications.

E. At cut slopes, extended netting over the top of the cut onto native soils a minimum distance of 4 feet and anchor it onto the undisturbed soils. This will allow for natural precipitation to will run over the netting and mulch.

F. On fill slopes, place netting over the top of the fill a minimum of 2 feet and securely staple it in place 4 feet beyond the top of slope. Compact the soils around the perimeter of the area to receive jute netting before placing netting to prevent moisture from undercutting the netting and causing displacement. Overlap the edges of each netting strip a least 4 inches, and staple the overlapped (double thickness) netting at 3-foot to 5-foot spacing depending on the conditions of the soil surface.

END OF SECTION

SECTION 32 92 00
REVEGETATION

PART 1 GENERAL

1.01 DESCRIPTION

A. The Contractor shall provide landscaping, revegetation and appurtenant work, complete and in accordance with the Contract Documents.

B. All disturbed areas shall be returned to the original grade on the Contract Drawings after completion of construction. All disturbed areas shall be revegetated except road pavement and shoulders, riprap and any specific cut slopes as defined in the Contract Documents. Disturbed areas shall be reclaimed to match and blend with characteristic landforms. When feasible, these areas shall be re-contoured and slopes rounded along access roads and wetland structures to blend with surrounding natural contours.

C. This revegetation plan provides guidelines to reestablish native vegetation at the site. This specification provides direction on soil preparation, erosion control, planting, watering, and plant establishment and maintenance requirements. Only seed certified to meet State Standards with regards to noxious weeds content shall be used.

1.02 DEFINITIONS

A. The terms “plant material” or “plants” refer to all vegetation and includes but is not limited to trees, shrubs, groundcover, or herbaceous vegetation.

1.03 REFERENCES

A. The following is a list of standards which may be referenced in this section.

1. FS O-F-241D: Fertilizer, Mixed, Commercial.
2. Agricultural Code of the State of Utah.

1.04 CONTRACTOR SUBMITTALS

A. Submit record drawings identifying planting locations, species, and other items in accordance with Section 01 33 00, Submittal Procedures.

B. Product Information: Manufacturer’s product information on fertilizer, seed mixtures, herbicide, wood fiber mulch, liquid tackifier, erosion control fabric, erosion control netting, anchorage device, straw mulch.

C. Certificates:

1. Certificates shall accompany each product delivery stating source, quantity, and type of material. All certificates shall be submitted at the time of delivery.
2. Certificates of inspection of plant material, as may be required by Federal, State or other authorities having jurisdiction, which accompany the shipment shall be submitted at delivery.

1.05 QUALITY ASSURANCE

A. General: All plants shall be true to type or name as indicated in the Contract Documents and shall be tagged in accordance with the standard practice recommended by the Agricultural Code of the State of Utah.

B. All plants shall comply with Federal and State laws requiring inspection for plant diseases and infestations.

C. The Contractor shall obtain clearance from jurisdictional agencies, as required by law, before planting plants delivered from outside the County in which they are to be planted. Evidence that such clearance has been obtained shall be filed with the Engineer.

D. The Contractor shall use state of the art practices to salvage, store, maintain and transplant existing plant materials.

E. Inspections will be made by the Project Representative. The Contractor shall request inspection at least 48 hours in advance of the time inspection is required. Inspection is required on the following stages of Work.

1. Prior to grading, identify plant material to be extracted, salvaged and relocated in other areas on the Project site.
2. After completion of grading and soil preparation, and prior to seeding and planting.
3. At the times when plant materials are delivered to the project site.
4. When planting, seeding, and all other indicated or specified Work except maintenance has been completed.
5. Upon completion of maintenance and plant establishment period.

1.06 CLEANUP

A. Upon completion of all planting operations, the portion of the Site used for a work or storage area by the Contractor shall be cleaned of all debris, superfluous materials, and equipment. All such materials and equipment shall be entirely removed from the Site.

B. During the entire Contract period, plant containers that have been cut or removed from plant materials, seed and fertilizer bags, wasted erosion control materials and anchorage devices shall be removed from the site daily.

C. Final cleanup of an area will be completed within 10 days after backfilling, including replacement of topsoil, final grading, and installation of permanent erosion-control structures. Each construction area will be fully cleaned up at the end of each construction season.

1.07 MAINTENANCE OF LANDSCAPING PLANTING PRIOR TO ACCEPTANCE OF PROJECT

A. General: The Contractor shall be responsible for protecting, weeding and maintaining all plantings until final acceptance of all Work under the Contract.

B. Upon completion of grass seeding, the entire area shall be soaked to saturation by a fine spray.

C. Protection: The Contractor shall provide adequate protection to all newly seeded areas including the installation of approved temporary fences to prevent trespassing and damage, as well as erosion control, until the end of the correction of defects period.

D. The Contractor shall replace any materials or equipment that its employees or Subcontractors have damaged.

E. Partial utilization of the project shall not relieve the Contractor of any of the requirements contained in the Contract Documents.

F. All seedings shall be fertilized two times during the maintenance period.

G. Plants shall be maintained in a vigorous, thriving condition by watering, fertilizing, spraying, and other operations necessary. No trees, shrubs, grasses or other groundcovers will be accepted unless they are healthy, established, and show satisfactory foliage conditions at the time all Work is completed.

1.08 FINAL INSPECTION AND GUARANTEE

A. Inspection of grass and plantings will be part of final inspection under the Contract.

B. Written notice requesting inspection shall be submitted to the Engineer at least 10 days prior to the anticipated inspection date.

C. Final acceptance prior to start of the guarantee period of the Contract will be on written approval by the Engineer, on the satisfactory completion of all Work, including maintenance, but exclusive of the replacement of plant material.

D. Any delay in the completion of any item of work in the planting operation which extends the planting into more than one season shall extend the correction period in accordance with the date of completion given above.

E. The Contractor shall replace, as soon as weather conditions permit, all dead plants and all plants not in a vigorous, thriving, condition which are noted at the end of the 1 year correction period.

F. Plants used for replacement shall be of the same size and species on the Plant List or the same species and size as was transplanted in the case of salvaged plant materials. Replacement plants shall be furnished, planted, fertilized, and mulched as indicated for new plants.

G. All Work under this section shall be left in good order to the satisfaction of the Owner and the Engineer, and the Contractor shall, without additional expense to the Owner, replace any trees, shrubs, seedings etc., which develop defects or die during the 1-year correction period. All seeded areas shall be weed-free and there shall be no bare spots or diseased areas.

PART 2 MATERIALS

2.01 GENERAL

A. All landscaping materials for soil conditioning, weed abatement, or planting shall be first-grade, commercial quality and shall have certificates indicating the source of material, analysis, quantity, or weight attached to each sack or container or furnished with each delivery. Delivery certificates shall be given to the Engineer as each shipment of material is delivered. A list of the materials used, together with typical certificates of each material, shall be submitted to the Engineer prior to final acceptance.

2.02 FERTILIZER AND ADDITIVES

A. Fertilizer shall be furnished in bags or other standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon.

B. Chemical fertilizers shall be a mixed commercial fertilizer conforming to FS O-F-241D, Type I, with percentages of nitrogen, phosphoric acid, and potash at specified rates. Fertilizers shall be uniform in composition, dry, and free flowing.

2.03 SEED MIXTURES

A. The seeding mixture for each planting area shall be as indicated in the table below.

Seed No.	Botanical Name	Common Name	Variety	Pounds per PLS Per Acre Broadcast	Percent of Mix	Seeds Per Sq. Ft.
1	Anchnatherum hymenoides	Indian ricegrass	Nezpar	4.8	28	15
4	Melilotus officinalis	Yellow Sweetclover	Madrid	0.5	2.8	3
5	Oenothera pallida	White evening primrose		0.4	2.2	4
6	Pascopyrum smithii	Western wheatgrass	Arriba	10.4	61	26
7	Poa sandbergii	Sandberg Bluegrass		0.7	4	14
9	Sporobolus cryptandrus	Sand dropseed		0.3	2	41
			Total	17.0	100.0	105

B. Supply seed on a pure live seed (PLS) basis.

C. Obtain seed from lots that have been tested by a state certified seed testing laboratory. (Association of Seed Analyst (AOSA) or Society of Commercial Seed Technologists (SCST).)

D. Seed germination test older than 18 months for grass seed, and 9 months for forb, shrub, or tree seed are not acceptable.

E. Do not use wet, moldy, or otherwise damaged seed.

F. Seed Substitutions:

1. Before requesting a seed substitution, contact the major seed brokers in the state to verify that the seed is unavailable.
2. Have the Engineer contact a Landscape Architect to verify the seed is unavailable and to recommend a seed substitution.
3. Replacement seed shall be of equal or greater cost to the originally specified seed.

2.04 HERBICIDE

A. Herbicide application is necessary only in the case where the Contractor allows Utah State listed noxious weeds to propagate in the construction areas and on disturbed soils for species where bio controls are not available.

B. Herbicide shall be a Banvel 4-W.S. (4 pounds active ingredient per gallon) and 2,4-D Ester (4 pounds active ingredient per gallon) mixture will be used at 1 pint to 2 quarts Banvel/1-2 quarts 2,4-D per 99 gallons and applied by backpack sprayers. The treatment of noxious weeds will not occur within 100 feet of open water or marsh land areas.

2.05 HYDROSEEDING

A. The hydroseed mix should be in a slurry having 60 pounds per acre of tackifier and 400 pounds per acre of wood fiber mulch. The tackifier shall be derived from natural organic plant sources containing no growth- or germination-inhibiting materials, capable of hydrating in water.

B. Wood fiber mulch shall be processed wood fiber containing no growth- or germination-inhibiting materials, dyed a suitable color to ascertain material placement, and when hydraulically applied to the ground, shall allow absorption and percolation of moisture.

2.06 EROSION CONTROL (JUTE NETTING)

A. Jute netting shall be a woven jute, undyed and unbleached with a fabric weight of 0.92 pounds per square yard. Jute netting shall be Belton Industries, Inc., 1-800-225-4099, “or-equal.”

2.07 STAPLES FOR JUTE NETTING

A. The staples shall be made of wire, 0.91-inch in diameter or greater, “U” shaped with legs 6 inches in length and a 1-inch crown. Size and gauge of staples used may vary with soil conditions and shall be reviewed by the Engineer.

2.08 STRAW MULCH

A. Material for straw mulching shall consist of the straw from oats, barley, wheat, or rye, and shall be seed-free or fumigated to prevent introduction of weeds. At least 50 percent of the mulch by weight shall be 10 inches or more in length. Old, dry, straw that breaks and does not bend is unacceptable.

2.09 NATIVE TOPSOIL

A. Native topsoil (strippings) shall be stockpiled and re-used.

2.10 IMPORTED TOPSOIL

A. As specified in Section 32 91 13, Soil Preparation.

PART 3 EXECUTION

3.01 NOXIOUS WEED CONTROL

A. The desired plant species shall be established as quickly as possible after construction to prevent the growth of noxious weeds.

B. Topsoil and waste soil material stockpiles shall have interim seeding and weed control if they would remain barren for extended periods during the growing season.

3.02 GROUND PREPARATION

A. The Contractor shall perform rough grading on slopes to be seeded to the lines and grades shown on Contract Drawings. All areas shall be lowered below finished grade proportionate with available native topsoil to allow for placement and spreading of topsoil. Slope to drain as shown on Contract Drawings. Prepare ground surface for seeding by replacing topsoil removed during clearing and grubbing and spreading it evenly over the areas to be hydroseeded to minimum depth of 6 inches.

B. On all areas to be seeded, the Contractor shall till the soil surface immediately prior to seeding.

C. On slopes steeper than 3:1, rake soils perpendicular to the slope or run bulldozer tracks up and down the slope to create small horizontal ledges for the seedbed. Where slopes are flatter than 3:1, till the topsoil to a depth of 4 inches with tillage oriented perpendicular to the slope.

3.03 TOPSOIL AND SEEDING

A. All areas disturbed by construction shall receive a minimum thickness of 12 inches of topsoil unless indicated otherwise on Drawings, and shall be seeded with the specified seed mixtures outlined in the planting plan. Planting shall not be conducted at:

1. Hard rock cut slopes.
2. Road pavement and road shoulders to edge of shoulder.

3. Minor approach roads to edge of shoulder.
4. Riprap.

B. All bald spots where the drill malfunctioned or there was not adequate drill overlap shall be replaced by the Contractor at no expense to the Owner.

3.04 REPLACEMENT OF HERBACEOUS SPECIES

A. All disturbed slopes flatter than 15 percent from horizontal shall be seeded by drilling, in accordance with the planting plan. For all slopes steeper than 15 percent, broadcast the seed and then hydroseed (with tackifier and wood fiber mulch). All reseeding efforts shall be conducted in November or later. Notify Engineer 2 days before commencement of drilling, broadcasting, or hydroseeding. Hydroseeding (with tackifier and wood fiber mulch) is not required on areas that are to be covered with an erosion control blanket.

B. In the areas not drilled, seeding shall be accomplished by a two-step process.

1. Step 1: Broadcast the seed.
2. Step 2: Hydroseed (with tackifier and wood fiber mulch).

3.05 HYDROSEEDING

A. General: Areas specified to be seeded shall be hydroseeded or drill seeded if flat and larger than 1/2 acre. All hydroseeding shall be accomplished between November to December or in March.

B. Equipment: Mixing shall be performed in a tank. The tank shall have a built-in continuous agitation and circulation system, of sufficient operating capacity to produce a homogenous slurry of mulch, stabilizer, seed, fertilizer and water in the designated unit proportions for a minimum coverage of 1/2 acre. The tank shall have a discharge system which will permit attachment of at least 500 feet of hose extensions, a change of elevation of 150 feet in height from tank to discharge nozzle, and still retain enough pressure to apply the slurry to the areas at a continuous and uniform rate.

C. Proportions: Proportions per acre shall be as follows:

1. Mulch: 2,500 pounds.
2. Seed: Proportioned to mixture of seed as specified herein.
3. Stabilizer: 120 pounds.
4. Fertilizer: 400 pounds.
5. Water: 3,000 gallons.

D. Application:

1. With agitation system operating at part speed, water shall be added to the tank and good recirculation shall be established. Materials shall be added in such a manner that they are uniformly blended into the mixture.
2. When the tank is 1/3 filled with water, add the following materials in the sequence listed:
   a. Sequence: Material:
      1) Stabilizer: 1/2 acre requirement.
      2) Three 50-pounds bales mulch.
      3) Seed: 1/2 acre requirement.
      4) Fertilizer: 1/2 acre requirement.
3. Agitate mixture at full speed when the tank is half filled with water.
4. Add remainder of mulch requirement before tank is 3/4 full.
5. Slurry distribution shall begin immediately. Application of slurry shall be done only when rain is not anticipated for at least 3 days after slurry application.
6. The entire tank of each batch of slurry shall be emptied and the slurry evenly applied to areas to be hydroseeded within a 2-hour period following the mixing of each slurry batch. Slurry batches not applied during this time will be rejected.

END OF SECTION

SECTION 33 05 01
CONVEYANCE PIPING—GENERAL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI): 301, Specifications for Structural Concrete.
2. American Water Works Association (AWWA):
   a. C110/A21.10, Ductile-Iron and Gray-Iron Fittings.
   b. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
   c. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 in. Through 144 in. (100 mm Through 3,600 mm).
   d. C210 Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
   e. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
   f. C217, Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines.
   g. C219, Bolted, Sleeve-Type Couplings for Plain-End Pipe.
   h. C221, Fabricated Steel Mechanical Slip-Type Expansion Joints.
   i. C606, Grooved and Shouldered Joints.
3. ASTM International (ASTM):
   a. A497/A497M, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
   b. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   c. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   d. C150/C150M, Standard Specification for Portland Cement.
   e. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
4. NSF International (NSF):
   a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
   b. NSF/ANSI 372, Drinking Water System Components - Lead Content.

1.02 SUBMITTALS

A. Action Submittals:

1. Detailed pipe fabrication drawings showing pipe details, special fittings and bends, dimensions, coatings, and other pertinent information.
2. Layout drawing showing location of each pipe section and each special length.
3. Pipe pressure class.
4. Wall thickness, reinforcing, and strength calculations.
5. Product Data: Manufacturer's data for couplings, saddles, gaskets, and other pipe accessories. Indicate maximum rated working pressure and test pressure for each item.
6. A complete and coordinated submittal of all flanges on the Project. Include information sufficient to verify complete compliance with Drawings and specifications for all items relating to all flanges including, but not limited to:
    a. Flange class, facing, quantities and where used.
    b. Flange Details: All AWWA, ANSI, and ASME Standard Flange Class information (provide full listings of all materials and dimensions and compatibility with other standard flange classes).
    c. Gasket Details: Type, material, diameter, thickness.
    d. Bolts, Rods, Nuts, Washers: All lengths, quantities, bolt/hole diameters, material strengths, metal finishes (zinc plated) provide all materials and dimensions mentioned in PCC-1 Guidelines.
    e. Torque requirements for each flange, bolt, and gasket. recommended by each flange or gasket manufacture (of piping, valves, meter, dismantling joints, etc.).
    f. Facing Details: Finish grade, faces with and without gasket groves.
    g. Mating flange facing for all valves, meters, dismantling joints, insulating flanges, etc. (see Section 26 42 01, Pipe Bonding and Test Stations, and Section 40 27 02, Valves and Operators).

B. Informational Submittals: Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.

1.03 DELIVERY, STORAGE, AND HANDLING

A. In accordance with manufacturer's recommendations and as specified in individual specification(s) following this section.

B. Marking at Plant: Mark each pipe and fitting at plant. Include date of manufacture, manufacturer's identification, specification standard, diameter of pipe number for laying purposes, and other information required for type of pipe.

C. Pipe, specials, and fittings received at Project Site in damaged condition will not be accepted.

D. Gasket Storage: Store rubber gaskets in cool, well ventilated place, and do not expose to direct rays of sun. Do not allow contact with oils, fuels, petroleum, or solvents.

E. Store and support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.

F. Handling:

1. Pipe shall be handled with proper equipment in a manner to prevent distortion or damage. Use of hooks, chains, wire ropes, or clamps that could damage pipe, damage coating or lining, or kink and bend pipe ends is not permitted.
2. Use heavy canvas, or nylon slings of suitable strength for lifting and supporting materials.
3. Lifting pipe during unloading or lifting into trench shall be done using two slings placed at quarter point of pipe section. Pipe may be lifted using one sling near center of pipe, provided pipe is guided to prevent uncontrolled swinging and no damage will result to pipe or harm to workers. Slings shall bear uniformly against pipe.
4. Pipe and fittings shall not be stored on rocks or gravel, or other hard material that might damage pipe. This includes storage area and along pipe trench.

PART 2 PRODUCTS

2.01 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 PIPE

A. As specified in the individual specification(s) following this section.

2.03 JOINTS

A. As specified in the individual specification(s) following this section.

2.04 COUPLINGS

A. General:

1. Coupling linings for use in potable water systems shall be in conformance with NSF/ANSI 61.
2. Couplings shall be rated for appropriate operating pressure and hydrostatic test pressure.
3. Exposed, bolted, sleeve-type couplings shall be lined and coated with fusion bonded epoxy in accordance with AWWA C213.
4. Buried, bolted, sleeve-type couplings shall be lined and coated with fusion-bonded epoxy in accordance with AWWA C213 and wrapped with petroleum wax tape in accordance with AWWA C217.

B. For Pipe with Plain-Ends:

1. Bolted, sleeve-type coupling, in accordance with AWWA C219.
   a. Manufacturer of couplings shall observe same quality control requirements as specified in AWWA C221 for fabrication of pipe expansion joints.
   b. Unless thrust restraint is provided by other means, bolted, sleeve-type couplings shall be harnessed. Harness details shall be in accordance with requirements of appropriate reference standard or as shown on Drawings. Contractor shall coordinate with flexible coupling manufacturer to ensure the thrust tie rods clear the flexible coupling components, including the follower rings.
   c. Certified Welding Inspector at coupling fabrication facility shall verify welders and welding procedures are qualified, procedures are being followed, and quality assurance functions are being implemented.
   d. Pipe Type to be Joined: As shown on Drawings.
   e. Pipe Ends Tolerance: Conform to Table 4 of AWWA C219.
   f. Pipe Outside Diameter, Including Coating: As shown on Drawings or as specified in the individual specification(s) following this section.
   g. Rated Working Pressure: 200 psi.
   h. Operating Temperature Range: 35 degrees F to 70 degrees F.

i. Maximum Allowable Angular Deflection of Pipe: 75 percent of manufacturer's recommended allowable deflection.
j. Additional Nondestructive Weld Evaluation: Dye penetrant test for all welds.
k. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.

C. For Pipe with Grooved Ends:

1. Grooved couplings, in accordance with AWWA C606. System shall provide for flexible joints. Grooves shall be cut into the pipe or contain a shoulder with a cut groove that is cast or subsequently welded or threaded onto the pipe. Roll grooves are not allowed.
2. Exposed couplings shall be lined and coated with fusion bonded epoxy in accordance with AWWA C213.
3. Buried couplings shall be lined and coated with fusion bonded epoxy in accordance with AWWA C213 and wrapped with petroleum wax tape in accordance with AWWA C217.
4. Manufacturer and Product:
   a. Victaulic; Style W77 AGS.
   b. "Or-equal."

D. For Pipe with Flanged Ends (including Dismantling Joints):

1. Flanged coupling adapters, in accordance with AWWA C219.
   a. Pipe Type to be Joined: As shown on Drawings.
   b. Pipe Ends Tolerance: Conform to Table 4 of AWWA C219.
   c. Pipe Outside Diameter, Including Coating: As shown on Drawings or as specified in the individual specification(s) following this section.
   d. Rated Working Pressure: 200 psi.
   e. Operating Temperature Range: 35 degrees F to 70 degrees F.
   f. Maximum Allowable Angular Deflection of Pipe: 75 percent of manufacturer's recommended allowable deflection.
   g. Nondestructive Examination Requirements: Dye penetrant test for all welds.
   h. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
2. Dismantling Joints:
   a. Dismantling joints for connecting flanged pipe shall be AWWA C219 compliant.
   b. Dismantling joint shall consist of a self-contained flanged restrained joint fitting that allows for longitudinal adjustment. Provide as a complete assembly consisting of flanged spigot piece, flange adapter, follower ring and bolts, tie bars, and gasket.

c. Nominal laying length shall be manufacturer's standard except where otherwise shown on Drawings.
d. Flanges shall be in accordance with AWWA C207 Class D or ANSI Class 150 flanges with raised face removed. The thickness of the flange shall be equal to or greater than the class of flange that it will be connected to.
e. No part of the restraint system shall extend outside the flange diameter. Internal bore shall match or exceed that of the adjoining pipe. Gasket seal and compression stud and nut arrangement shall be separate and independent of the tie bar restraint system. All dismantling joints shall be of the restrained type unless otherwise indicated on Drawings.
f. Tie Bars:
    1) Diameter shall be equal to flange bolts.
    2) Minimum quantity of tie bars shall be equal to one fourth of the number of flange bolt holes or four, whichever is greater.
g. Materials:
    1) Flanges: All dismantling joints shall use standard flanges in accordance with AWWA C207, Class D or ANSI Class 150 flanges.
    2) Tie Bars: Stainless steel Type 316 threaded rod, rolled threads, ASTM A193, Grade B7 or Grade B7M.
    3) Follower ring bolt material shall match tie bars.
    4) Gasket Material: Ethylene propylene diene rubber (EPDM), Grade E. Other gasket materials as listed in AWWA C219 may be acceptable, subject to approval by the Engineer.
h. Coating and lining of dismantling joint shall be fusion bonded epoxy in accordance with AWWA C213. Buried couplings shall also be greased and wrapped with petroleum wax tape coating per AWWA C217.
i. Manufacturer:
    1) Baker Couplings.
    2) "Or-equal."

2.05 SERVICE SADDLES

A. Service saddles shall not be used on any pipe unless specifically shown on Drawings.

2.06 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

A. Modular Mechanical Seal:

1. Type: Interconnected synthetic rubber links shaped and sized to continuously fill annular space between pipe and wall sleeve opening.
2. Assemble interconnected rubber links with Type 316 stainless steel bolts, nuts, and pressure plates.
3. Size modular mechanical seals according to manufacturer's instructions for the size of pipes shown to provide a watertight seal between pipe and wall sleeve opening.
4. Manufacturers and Products:
   a. Thunderline/LinkSeal, Div. of PSI, Houston, TX; Link Seal.
   b. Calpico, Inc., South San Francisco, California; Sealing Linx.
   c. Advance Products and Systems, Lafayette, Louisiana; Innerlynx.

B. Wall Sleeves:

1. Diameter, ends, and length shall be as shown on Drawings.
2. Shall include integral seep ring to minimize seepage between metal sleeve and concrete.

C. Wall Couplings:

1. Diameter, ends, and length shall be as shown on Drawings.
2. Wall couplings shall provide flexible mechanical joint.
3. Body and end rings shall be coated with fusion bonded epoxy.
4. Body shall include integral seep ring.
5. Shall comply with AWWA C219.

D. If core drilling is required for penetrations of existing concrete walls or slabs, locations of drilling shall be determined by radiograph to avoid damage to reinforcing steel and conduits.

2.07 FLANGES (INCLUDING MATING FLANGES FOR VALVES, METERS, DISMANTLING JOINT AND OTHER PIPING)

A. Steel Flanges: Use steel flanges unless noted otherwise.

B. Use steel flanges as follows (except where the specified valves or Drawings require otherwise):

1. AWWA C207 Class D flanges. Weld steel flanges to steel pipe per AWWA C207 and as indicated on Drawings. Flanges for valves, meters, and couplings shall match adjacent steel flanges.

2. Insulating Flanges: Provide flat faced insulating flanges, with flange kits per Section 26 42 01, Pipe Bonding and Test Stations, and bolt holes 1/8-inch oversized for insulating sleeves (per AWWA C207), except 30-inch to 42-inch flanges shall have 1/4 inch (not 1/8-inch) oversized bolt holes.

C. Ductile and Cast Iron Flanges Mated to Steel Flanges: Provide valves specified which are rated for design pressures, then select steel flanges that mate to those valves. Use specified valves with either steel flanges or ductile/cast iron flanges which mate to ASME B16.5 or ASME B16.47 Class 150 steel flanges. Mated steel to ductile (or cast) iron flange assemblies shall be rated for project design pressures.

D. Flanges fabricated from steel plate shall meet the requirements of ASTM A516, Grade 70. Forged steel flange material shall conform to ASTM A105/A105M. Castings shall conform to ASTM A216 WCB.

E. Wrap buried flanges with petroleum wax tape per AWWA C217.

F. Coordinate and mate all flanges and gaskets in submittals (for valves, meters, insulating flanges, couplings, etc.) so that mating flanges are both of the same flange type and coordinate facing. Unmated flanges (of dissimilar facing, gasket or type) shall be corrected at Contractor expense.

G. Flanges shall be faced and not coated from the factory. Contractor shall coordinate inside and outside diameter of flanges with mated equipment, such as valves. Any exposed flange surfaces, after mating, shall be field coated.

H. Comply with all detailed requirements and provide a comprehensive flange submittal. Submit each mated flange assembly signed jointly by the manufacturer of both flanges (i.e., pipe to valve, valve to meter, meter to dismantling joint, etc.).

2.08 BOLTS AND NUTS FOR FLANGES

A. Bolts for flanges located indoors, in vaults, outdoors above ground and in flange insulation kits shall be ASTM A193, Grade B7, with nuts conforming to ASTM A194, Grade 2H. Zinc plate steel bolts and nuts unless noted otherwise.

B. Bolts for buried flanges shall be Type 316 stainless steel, ASTM A193/A193M, Grade B8M hex head bolts; and ASTM A194/A194M, Grade 8M hex head nuts. Fabricate in accordance with ASME B18.2.2.

C. Provide washers for each bolt and nut. Washers shall be of the same material as the nuts.

2.09 GASKETS

A. For pipes with flat face and raised face flanges, use full-face gaskets NSF 61 Certified.

1. Products: Garlock “Multi-Swell, Style 3760-U”, “or-equal.” Gaskets shall be rated for a pressure of 500 psi at a temperature of 400 degrees F.
2. Contractor shall coordinate with equipment manufacturer (including valves) to ensure specified gasket is acceptable. Notify Engineer if any equipment supplier requires special gaskets. Contractor shall provide special gaskets as may be required by selected manufactures and as approved by the Engineer.

B. Insulating flange gaskets shall be per Section 26 42 01, Pipe Bond and Testing Stations.

2.10 PIPE LOCATING TAPE

A. As specified in Section 31 23 23.15, Trench Backfill.

2.11 PIPE BEDDING AND PIPE ZONE MATERIAL

A. As specified in Section 31 23 23.15, Trench Backfill.

2.12 TRENCH STABILIZATION MATERIAL

A. As specified in Section 31 23 23.15, Trench Backfill.

PART 3 EXECUTION

3.01 GENERAL

A. Notify Engineer at least 2 weeks prior to field fabrication of pipe or fittings.

B. Furnish feeler gauges of proper size, type, and shape for use during installation for each type of pipe furnished.

C. Distributing Materials: Place materials along trench only as will be used each day, unless otherwise approved by Engineer. Placement of materials shall not be hazardous to traffic or to general public, obstruct access to adjacent property, or obstruct others working in area.

3.02 EXAMINATION

A. Verify size, material, joint types, elevation, and horizontal location of existing pipeline to be connected to new pipeline or new equipment.

B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

C. Damaged Coatings and Linings: Repair using coating and lining materials in accordance with manufacturer's instructions.

3.03 PREPARATION OF TRENCH

A. Prepare trench as specified in Section 31 23 16, Excavation.

B. Unless otherwise permitted by Engineer, maximum length of open trench shall not exceed 500 feet including trench excavation ahead of pipe laying, pipe in open trench, and backfill to finished grade.

3.04 INSTALLATION

A. General:

1. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.
2. Install individual pipe lengths in accordance with approved lay diagram. Misplaced pipe shall be removed and replaced.
3. Inspect pipe and fittings before installation, clean ends thoroughly, remove foreign matter and dirt from inside.
4. Flanged Joints:
    a. Install perpendicular to pipe centerline.
    b. Bolt Holes: Straddle vertical centerline, aligned with connecting equipment flanges or as shown on Drawings.
    c. Use torque-limiting wrenches to provide uniform bearing and proper bolt tightness.
    d. Flange Type: Use flat-faced flange when joining with flat-faced ductile or cast iron flange.
5. Couplings:
    a. Install in accordance with manufacturer's written instructions.
    b. Before coupling, clean pipe holdback area of oil, scale, rust, and dirt.
    c. Clean gaskets before installation.
    d. If necessary, lubricate with gasket lubricant for installation on pipe ends.
    e. Tighten coupling bolts progressively, drawing up bolts on opposite sides gradually until bolts have uniform tightness.

B. Buried Pressure Pipe:

1. Concrete Encased or Embedded Pipe: Do not encase joints in concrete, unless specifically shown on Drawings.
2. Placement:
   a. Keep trench dry until pipe laying and joining is completed.
   b. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.
   c. Measure for grade at pipe invert, not at top of pipe.
   d. Excavate trench bottom and sides of ample dimensions to permit proper joining, welding, visual inspection, and testing of entire joint.
   e. Prevent foreign material from entering pipe during placement.
   f. Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.
   g. In general, lay pipe upgrade with bell ends pointing in direction of laying.
   h. Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:
      1) Shorter pipe lengths.
      2) Special mitered joints.
      3) Standard or special fabricated bends.
   i. Check gasket position with feeler gauge to assure proper seating.
   j. After joint has been made, check pipe alignment and grade.
   k. Place sufficient pipe zone material to secure pipe from movement before next joint is installed.
   l. Prevent uplift and floating of pipe prior to backfilling.
3. Tolerances:
   a. Deflection From Horizontal Line: Maximum 2 inches.
   b. Deflection From Vertical Line: Maximum 1 inch.
   c. Joint Deflection: Maximum of 75 percent of manufacturer's recommendation.
   d. Horizontal position of pipe centerline on alignment around curves maximum variation of 1 foot from position shown.
4. Cover Over Top of Pipe: As shown on Drawings.
5. Disposal of Excess Excavated Material: As specified in Section 31 23 16, Excavation.

3.05 THRUST RESTRAINT

A. Restrained welded joints as shown on Drawings. Provide concrete encasement and thrust blocking where specifically shown on Drawings.

3.06 CORROSION PROTECTION

A. Buried Pipe: As specified in the individual specifications following this section.

B. Buried Flanges and Couplings: All buried flanges and couplings shall be greased and wrapped with petroleum wax tape coating per AWWA C217.

C. Notify Engineer at least 3 days prior to start of surface preparation, coating application, and corrosion protection work.

3.07 PLACEMENT OF PIPE LOCATING TAPE

A. Place pipe locating tape in accordance with Section 31 23 23.15, Trench Backfill.

3.08 PIPE BEDDING AND ZONE MATERIAL

A. Place pipe bedding and pipe zone material in accordance with Section 31 23 23.15, Trench Backfill.

3.09 FIELD QUALITY CONTROL

A. Pressure Leakage Testing: As specified in Section 40 80 01, Piping Leakage Testing.

3.10 CLEANING AND DISINFECTION

A. Following assembly and testing, and prior to disinfection and final acceptance, flush pipelines with water at 2.5 fps minimum flushing velocity until foreign matter is removed. Dispose of water and flushed foreign matter.

B. For pipelines 24 inches or larger in diameter, acceptable alternatives to flushing are use of high-pressure water jet, sweeping, or scrubbing. Water, sediment, dirt, and foreign material accumulated during this cleaning operation shall be discharged, vacuumed, or otherwise removed from the pipe.

C. Remove accumulated debris through blowoffs 2 inches and larger or by removing spools and valves from piping.

D. Disinfection: As specified in Section 33 13 00, Disinfection of Water Utility Distribution Facilities.

END OF SECTION

SECTION 33 05 01.01
WELDED STEEL PIPE AND FITTINGS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Mechanical Engineers (ASME):
   a. B16.9, Factory-Made Wrought Buttwelding Fittings.
   b. B36.10M, Welded and Seamless Wrought Steel Pipe.
   c. BPVC SEC VIII, Div. 1, Rules for Construction of Pressure Vessels.
   d. BPVC SEC IX, Welding and Brazing Qualifications.
2. American Society for Nondestructive Testing Inc. (ASNT):
   SNT-TC-1A, Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing.
3. American Water Works Association (AWWA):
   a. C200, Steel Water Pipe - 6 In. (150 mm) and Larger.
   b. C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. (100 mm) and Larger - Shop Applied.
   c. C206, Field Welding of Steel Water Pipe.
   d. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm.
   e. C208, Dimensions for Fabricated Steel Water Pipe Fittings.
   f. C602, Cement-Mortar Lining of Water Pipelines in Place - 4 In. (100 mm) and Larger.
   g. M11, Steel Pipe - A Guide for Design and Installation.
4. American Welding Society (AWS):
   a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
   b. A3.0M/A3.0, Standard Welding Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying.
   c. D1.1/D1.1M, Structural Welding Code - Steel.
   d. QC 1, Standard for AWS Certification of Welding Inspectors.
5. ASTM International (ASTM):
   a. A20/A20M, Standard Specification for General Requirements for Steel Plates for Pressure Vessels.
   b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   c. A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

d. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
e. A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
f. A435/A435M, Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates.
g. A516/A516M, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service.
h. A770/A770M, Standard Specification for Through-Thickness Tension Testing of Steel Plates for Special Applications.
i. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
j. A1018/A1018M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
k. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
l. E1255, Standard Practice for Radioscopy.

6. International Organization for Standardization (ISO): 9001:2000, Quality Management Systems - Requirements.
7. Lloyd’s Registry.
8. NSF International (NSF): 61, Drinking Water System Components-Health Effects.
9. Steel Pipe Fabricators Association (SFPA).

1.02 DEFINITIONS

A. Fittings: Including, but not limited to fittings, closure pieces, bends, reducers, tees, wyes, bifurcations, crosses, outlets, manifolds, nozzles, wall sleeves, bulkheads, and other piping and appurtenances fabricated from steel plate, sheet, or coils as required to provide the Work, complete. Fittings shall include piping above ground or inside structures.

B. Acronyms:

1. CJP: Complete Joint Penetration.
2. CWI: Certified Welding Inspector.
3. MT: Magnetic Particle Testing.
4. NDE: Nondestructive Examination.
5. NDT: Nondestructive Testing.
6. PJP: Partial Joint Penetration.

7. PQR: Procedure Qualification Record.
8. PT: Liquid Penetrant Testing.
9. RT: Radiographic Testing.
10. UT: Ultrasonic Testing.
11. VT: Visual Testing.
12. WPQ: Welder/Welding Operator Performance Qualification.
13. WPS: Welding Procedure Specification.

1.03 DESIGN REQUIREMENTS

A. Fittings:

1. Design reinforcement, unless otherwise shown.
2. Design in accordance with AWWA M11, AWWA C200, and AWWA C208 as modified herein, and this Specification.

B. Pipe Layout: Design in accordance with AWWA M11:

1. General:
   a. Base stationing and elevation convention as shown on Drawings.
   b. Maximum Laying Lengths:
      1) Not limited, unless specifically shown on Drawings.
      2) Select lengths to accommodate installation operation.
2. Include, as minimum:
   a. Specific number, location, and direction of each pipe, joint, and fitting. Number each pipe in installation sequence.
   b. Station and centerline elevation at changes in grade or horizontal alignment.
   c. Station and centerline elevation to which bell end of each pipe will be laid.
   d. Elements of curves and bends, both in horizontal and vertical alignment.
   e. Location of mitered pipe sections, beveled ends for alignment conformance, butt straps, and deep bell lap joints for temperature stress control.
   f. Location of closures, cutoff sections for length adjustment, temporary access manways, vents, and weld lead outlets for construction convenience.
      1) Provide for adjustment in pipe laying headings and to conform to indicated stationing.
      2) Changes in location or number will require Engineer approval.
   g. Location of bulkheads, both those shown and as required, for hydrostatic testing of pipeline.

C. Welding Procedure Specification (WPS):

1. Qualified by testing in accordance with ASME BPVC SEC IX for shop welds and AWS D1.1/D1.1M for field welds.
2. PQRs conducted on unlisted base metal (most coil products are unlisted base metals) to be production welded as required in the referenced welding Code shall be traceable to heat lots.
3. Written WPS required for welds, both shop and field.

D. Stulling (Strutting): Design for pipe and fittings such that over-deflection and damage is avoided during handling, storage, and installation, including backfill and compaction.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings showing pipe layout.
2. Material list and steel reinforcement schedules for materials specified.
3. Fabrication Information:
    a. Pipe and fitting details for temporary and permanent facilities indicating:
        1) Cylinder thickness.
        2) Manufacturing tolerances.
        3) Maximum angular deflection limitations of field joints.
        4) Closure sections and cutoffs for field length adjustment.
        5) Bulkheads, including details for removal of test bulkheads and repair of lining.
        6) Weld lead outlets and plugs.
        7) Stulling size, spacing, and layout.
    b. Welded joint details including:
        1) Butt joints.
        2) Miter-cut ends for alignment conformance.
        3) Lap joints.
        4) Special thermal control joints required for control of temperature stresses.
        5) Butt strap joints.
4. Welding Data (Shop and Field Welding):
    a. Show on a weld map, complete information regarding base metal specification designation location, type, size, and extent of welds with reference called out for WPS and NDE numbers in tail of welding symbol.
    b. Distinguish between shop and field welds.

c. Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint welding details showing bevels, groove angles, and root openings for all welds.
d. Welding and NDE symbols shall be in accordance with AWS A2.4.
e. Welding terms and definitions shall be in accordance with AWS A3.0M/A3.0.
f. Submit welding data together with Shop Drawings as a complete package.

5. Product data for the following:
   a. Welded Steel Pipe and Fittings:
      1) Material data.
      2) Chemical and physical test reports showing data consistent with specified requirements for each heat of steel proposed for use.

B. Informational Submittals:

1. Certificates:
   a. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
   b. Lining Materials: Certificate that lining system is currently approved for potable water contact in accordance with NSF 61 and satisfies current applicable governmental health and safety requirements for use in potable water.
2. Pipe Manufacturer's written Quality Assurance/Control Plan.
3. Statements of Qualification:
   a. Pipe manufacturer.
   b. Fittings fabricator.
   c. Contractor's Shop Inspector.
   d. Contractor's Field Inspector.
   e. NDT Quality Control Personnel.
4. Procedures:
   a. Shop and field welding information; at a minimum include complete welding code paper trail with linkage to Shop Drawings.
   b. Welder Qualifications and Welding Procedure Specifications in as specified below:
      1) Provide complete joint dimensions and details showing bevels, groove angles, root face, and root openings for all welds.
      2) Written NDT procedures.

3) Written description of proposed sequencing of events or special techniques such as:
   a) Controlling pipe wall temperature stress during installation.
   b) Minimizing distortion of steel.
   c) Shop-Applied Cement-Mortar Lining: Include description of machine to be used and list of similar projects where machine was used. Identify pipe size and total footage.
   d) Monitoring pipeline temperatures during installation.

c. Written weld repair procedures for the Work.
d. Field coating application and repair.
e. Field lining application and repair.

5. Reports:
   a. Source Quality Control Test Reports:
      1) Nondestructive weld testing.
      2) Steel impact testing using Charpy V-notch method.
   b. Field Quality Control Test Reports:
      1) Weld tests, including re-examination of repaired welds, on each weld joint for the following tests, as applicable:
         a) RT.
         b) UT.
   c. Cement-mortar lining compressive strength tests in accordance with AWWA C205.
   d. Cement-mortar coating absorption tests in accordance with AWWA C205.
6. Field Testing Plan: Submit at least 15 days prior to testing and include following information at a minimum:
   a. Testing dates.
   b. Piping system and sections to be tested.
   c. Method of isolation.
   d. Method of conveying water from source to system being tested.
   e. Calculation of maximum allowable leakage for piping sections to be tested.
7. Temperature Stress Control Plan: Submit at least 45 days prior to installing pipe and include at least the following information:
   a. Step by step installation procedures and sequencing to demonstrate compliance with temperature control requirements, including:
      1) Pipe installation.
      2) Joint welding of standard joints and temperature control joints.
      3) Pipe bedding and backfill.
   b. Methods to ensure compliance with procedures by installation personnel.

c. Equipment to be used to monitor pipe wall temperature.
d. Time of day, climatic, or seasonal installation limits to be used to achieve compliance with temperature control requirements.

8. Pipe manufacturer's design engineer's certification of training of Contractor's pipe installation crews.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Pipe Manufacturer:
   a. Experienced in fabricating pipe of similar diameters, lengths, and wall thickness required for the Work.
   b. Steel Pipe Fabricators Association (SPFA), Lloyd's Registry Certification, or ISO 9001:2000 Certification.
   c. Demonstrate current production capability for volume of work required for Project.
   d. Experience shall include successful fabrication to AWWA C200 standards of at least 30,000 linear feet of 42-inch diameter or larger pipe, with wall thickness of 0.25 inch or greater, within past 5-year period.
   e. Experience shall be applicable to fabrication plant facilities and personnel, not company or corporation that currently owns fabrication facility or employs personnel.
2. Fittings Fabricator:
   a. Experienced in fabricating fittings of similar diameters and wall thickness required for the Work.
   b. Steel Pipe Fabricators Association (SPFA), Lloyd's Registry Certification, or ISO 9001:2000 Certification.
   c. Demonstrate current production capability for volume of work required for this Project.
   d. Experience shall include successful fabrication to AWWA C200 and AWWA C208 standards of at least 25 fittings of 42-inch or larger pipe, with wall thickness 0.25 inch or greater, within past 5-year period.
   e. Experience shall include successful fabrication of at least five crotch plate fittings requiring post weld heat treatment within past 5-year period.
   f. Experience shall be applicable to fabrication shop facilities and personnel, not company or corporation that currently owns fabrication facility or employs personnel.
3. Welders and Welding Operators:
   a. Shop Welders: In accordance with ASME BPVC SEC IX.
   b. Field Welders: In accordance with AWS D1.1/D1.1M.

4. Contractor's Inspector for Shop and Field Welding:
    a. In accordance with AWS QC 1, with knowledge of welding code for the Work.
    b. After receiving CWI qualification, at least one Shop CWI and one Field CWI shall have 5 years' minimum professional experience related to welding inspection similar to the Work. Other CWIs may work under the supervision of 5-year CWI, provided they have 1 year of related professional experience after receiving CWI qualification.
5. NDT Quality Control Personnel:
    a. In accordance with requirements of ASNT SNT-TC-1A, NDT Level II.
    b. After receiving NDT qualification, at least one NDT person shall have 5 years minimum professional experience related to NDT inspection similar to the Work. Other NDT personnel may work under the supervision of 5-year NDT, provided they have 1 year of related professional experience after receiving NDT qualification.

B. Contractor's Shop Inspector:

1. In accordance with AWWA C200.
2. Responsibilities:
    a. Verify conformance to use of specified materials and their proper storage.
    b. Monitor conformance to approved WPS.
    c. Monitor conformance to approved NDT procedure specifications.
    d. Monitor conformance of WPQ.
    e. Provide 100 percent visual inspection before, during, and after shop welding.
    f. Coordinate NDT work and review test results.
    g. Maintain records and prepare report confirming results of inspection and testing.

C. Contractor's Field Inspector:

1. In accordance with AWWA C206 and AWS D1.1/D1.1M.
2. Responsibilities:
    a. Verify conformance to use of specified materials and their proper storage.
    b. Monitor conformance to approved WPS.
    c. Monitor conformance to approved NDT procedure specifications.
    d. Monitor conformance of WPQ.
    e. Provide 100 percent VT before, during, and after field welding.

f. Coordinate NDT work and review test results.
g. Maintain records and prepare report confirming results of inspection and testing.

1.06 DELIVERY, HANDLING, AND STORAGE

A. Pipe Marking:

1. Legibly mark installation sequence number on pipe and fittings in accordance with piping layout. Standard pipe sections do not need sequence number labeled provided wall thickness is clearly marked.
2. Fittings shall be marked at each end with notation “TOP FIELD CENTERLINE.”
3. The word “TOP” shall be painted or marked on outside top spigot of each fitting.
4. Mark “TOP MATCH POINT” for compound bends per AWWA C208 so end rotations can be easily oriented in field.

B. Delivery:

1. Securely bulkhead or otherwise seal ends of pipe and fittings prior to loading at manufacturing site.
2. Pipe ends shall remain sealed until installation.
3. Damage to pipe and fittings, including linings and coatings, found upon delivery to Site shall be repaired to Engineer’s satisfaction or removed from Site and replaced.

C. Storage:

1. Support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.
2. Support on sand or earth berms free of rock exceeding 3 inches in diameter.

1.07 SEQUENCING AND SCHEDULING

A. Notify Engineer in writing of the following:

1. Pipe Manufacturing: Not less than 14 days prior to starting.
2. Not less than 10 days prior to start of each of the following:
   a. Welding.
   b. Coating application.
   c. Lining application.
   d. Shop hydrostatic testing.

PART 2 PRODUCTS

2.01 GENERAL

A. Pipe Manufacturer:

1. Manufacturing of steel pipe and fittings shall be under direction of one pipe Supplier.
2. Responsibility shall include, at minimum, coordinating work of other suppliers for fittings.

B. Pipe Size:

1. Unless shown otherwise for pipe 30 inches in diameter and larger, the diameter shown shall be considered finished inside diameter after lining.
2. For pipe smaller than 30 inches in diameter, diameter shown shall be per ASME B36.10M.
   a. Pipe size shall be nominal outside diameter for 14-inch diameter pipe and larger.
   b. Pipe size shall be nominal inside diameter for 12-inch diameter pipe and smaller.

C. Steel pipe and fittings shall be manufactured, tested, inspected, and marked to comply with AWWA C200 and additional requirements of these Contract Documents.

D. In lieu of collar reinforcement, pipe or fittings with outlets may be fabricated in their entirety of steel plate having thickness equal to sum of pipe wall plus required reinforcement.

E. Materials furnished shall be NSF 61 approved for use with potable water.

2.02 PIPE BARREL

A. Steel: Provide steel coils for spiral welded steel pipe or steel plate for straight seam welded steel pipe per AWWA C200 and as follows:

1. Specified Minimum Yield Strength: 36,000 psi.
2. Specified Minimum Tensile Strength: 53,000 psi.
3. Minimum Elongation in 2-inch Gauge Length: 21 percent.

4. Steel Quality as follows:
   a. Coils:
      1) Continuous cast process, fully-killed, fine grained practice conforming to physical, manufacturing and testing requirements of ASTM A1011/A1011M, structural steel Grade 36, Type 1 for steel coils less than 0.230 inch thick. For steel coils 0.230 inch thick or greater, use ASTM A1018/A1018M, structural steel Grade 36, Type 1.
      2) Measured yield strength shall not exceed 85 percent of measured tensile strength.
   b. Plate:
      1) Fully-killed, conforming to ASTM A20/A20M, fine grained practice conforming to physical, manufacturing and testing requirements of ASTM A516/A516M, Grade 70.
      2) Steel Chemistry: Conform to ASTM A516/A516M, Grade 70. Steel plates that are 3/4-inch thick or greater shall be normalized.
   c. Toughness:
      1) Charpy V-notch Acceptance Criteria: Transverse specimen orientation, full size specimens, 25 foot-pounds energy at test temperature of 30 degrees F.
      2) Frequency: See ASTM Steel Toughness Testing for Thickness Equal to or Greater than 7/16 Inches.
5. Minimum nominal wall thickness as shown on Drawings. Maximum allowable thickness variation for plate, sheet, or coil shall be 0.010 inch less than ordered thickness.

2.03 FITTINGS

A. Fabrication:

1. Shop fabricate. No field fabrication will be allowed, unless approved by Engineer.
2. Fabricate from materials or straight pipe in conformance with specified requirements and dimensions of AWWA C208, unless otherwise indicated.

B. Crotch Plate: Fabricate from fully-killed, fine grain, pressure vessel steel conforming to ASTM A516/A516M, Grade 70, and as follows:

1. Plates shall be normalized.
2. Perform through-thickness tension testing of plates in accordance with ASTM A770/A770M.

3. Charpy V-notch tests in direction transverse to final rolling shall be performed per ASTM A370 on full size specimens of coupons taken from each plate. Acceptance shall be 25 foot-pounds at 30 degrees F.
4. Steel Rod or Pin shall be ASTM A350, LF2.
5. Post weld heat treat (PWHT) completed wye after fabrication per ASME BPV Code Section VIII, Division 1, Paragraph UCS-56.

C. Wall Thickness:

1. General:
   a. Refer to ASME B36.10M for definitions of wall thickness for standard weight pipe and nominal pipe size (NPS).
   b. Reinforce to withstand either internal pressures, both circumferential and longitudinal, or external loading conditions, whichever is greater.
   c. Minimum Plate Thickness: The greater of adjacent mainline pipe, thickness shown, thickness calculated as hereinafter specified, or as shown in Table 1.

Table 1

Nominal Pipe Diameter (inches)	Pipe Manifolds Piping Above Ground Piping in Structures	Bends Reducers
24 and Under	Standard Weight	Standard Weight
Over 24	3/8 inch	3/8 inch

D. Bends, Unless Otherwise Indicated:

1. Minimum Radius: 1.0 times pipe diameter or as indicated on Drawings.
2. Minimum Bend Wall Thickness: Greater of Table 1 above or as calculated for straight pipe under internal pressure multiplied by following bend stress intensities (tabulated below or calculated with the following bend stress intensity formula where “n” is the bend radius multiplier and SI=bend stress intensity). For “n” greater than, or equal to, 2.5 the stress intensity factor may be ignored as indicated in AWWA M11.

$$SI = \frac{2 \cdot n - \frac{1}{3}}{2 \cdot n - 1}$$

Bend Radius Multiplier "n"	AWWA M11 Bend Stress Intensity "SI"
1.0	1.67
1.5	1.33
2.0	1.22

3. Maximum Miter Angle: 11-1/4 degrees on each section resulting in a maximum deflection angle of 22.5 degrees per miter weld as recommended in AWWA C208.
4. Bevels: Vary bevels on miters to provide a constant weld groove angle. For 11-1/4-degree miter, (22.5-degree miter weld) bevels must vary from 18.75 degrees on OD of bend to 41.25 degrees on ID of bend to provide a constant 60-degree groove angle for CJP welding.
5. Complete joint penetration (CJP) welds on miter welds.

E. Outlets:

1. 24 Inches and Smaller: Fabricate from ASTM A53/A53M, Type E or Type S, Grade B, standard weight steel pipe.
2. Larger than 24 Inches: Fabricate from ASTM A106/A106M, Grade B, standard weight pipe.
3. Fabricate collar or wrapper reinforcement using same steel as specified for main pipe barrel.

F. Steel Butt-Weld Fittings:

1. 24 Inches and Smaller: In accordance with ASME B16.9 conforming to ASTM A234/A234M.
2. Standard weight.
3. Taper pipe wall at welds at 4:1 for connection to pipe of different wall thickness.
4. Coordinate difference in diameter convention between fittings and AWWA C200 and AWWA C208 pipe and fittings to provide complete piping system as shown.

2.04 JOINTS

A. Shop Welded:

1. Fabricate in accordance with AWWA C200 as modified herein.
2. Complete joint penetration (CJP) butt joints shall be used for longitudinal, girth, and spiral welds, unless otherwise indicated.
3. Lengths of pipe shall not be shop-joined using lap joints.

B. Preparation of Joints for Field Welding:

1. Butt Joint Welded:
   a. Plain ends beveled as required by AWWA C200 and Contractor's field WPS.
   b. Provide protection for factory beveled pipe ends so ends are not damaged during transport.
2. Lap Joint Welded:
   a. Double fillet and single fillet lap joints in preparation for field welding shall be in accordance with AWWA C200.
   b. For pipe 30 inches in diameter and larger, provide one of the following:
      1) Tack weld four metal tabs at equal intervals around inside circumference of bell ends to indicate location at which spigot end has reached maximum penetration into bell. Remove stops after welding of joint.
      2) Paint a 3/4-inch wide white stripe on outside circumference of spigot end of pipe. Side of stripe furthest from pipe end shall indicate location at which spigot end has reached maximum penetration into bell. Side of stripe closest to end of pipe will indicate limit of maximum joint pull.
   c. Double welded lap joints and butt-strap joints shall be tapped and drilled for testing in accordance with AWWA C206.

C. Miter-End Cuts:

1. Welded Lap Joints:
   a. As shown on Drawings.
   b. Moderate deflections and long radius curves may be made using miter-end cuts.
   c. Use only with rubber gasket joints or lap welded joints, unless specifically approved in writing by Engineer.
   d. Maximum Total Allowable Angle: 5 degrees per pipe joint.
   e. Provide miter-cut that is cold expanded square with face of miter-cut on bell ends only.
   f. Mitering of spigot ends will not be permitted.
2. Welded Butt Joints:
   a. Maximum Total Allowable Angle: 2.5 degrees per pipe joint.
   b. Minimum Pipe Wall Thickness: 3/8 inch.
   c. Welded Butt joints shall be CJP.

D. Special Temperature Control Joint:

1. Provide a special longer bell end (Special Temperature Control Joint) at a maximum spacing as indicated herein to account for movement on installed pipe as a result of temperature changes.
2. Provide Minimum Special Temperature Control Joint length as shown on Drawings.

2.05 FLANGES

A. As specified in Section 33 05 01, Conveyance Piping—General.

2.06 STULLING (STRUTTING)

A. Materials:

1. Shop-Lined Pipe: Wood stulls and wedges.
2. Unlined Pipe: Steel or wood.

B. Install stulling for pipe and fittings in accordance with approved submittal and as soon as practical after pipe is fabricated or, for shop-lined pipe, after lining has been applied.

C. Install stulling in manner that will not harm lining.

2.07 PIPE COATING

A. For buried piping provide tape coating with cement mortor over coat as specified in Section 09 97 13, Pipeline Tape Coating.

B. For exposed piping provide coating as specified in Section 09 90 00, Painting and Coating.

2.08 CEMENT-MORTAR LINING

A. General:

1. Notify Engineer at least 3 days prior to application of lining products.
2. Holdback of lining from field-welded joints shall be as shown on Drawings.

B. Shop-Applied:

1. Applied centrifugally in conformance with AWWA C205. Thickness shall be in accordance with AWWA C205.
2. Lining machine type that has been used successfully for similar work and approved by Engineer.

3. Maintain pipe in round condition during lining operation and thereafter by suitable bracing or strutting.
4. Provide polyethylene or other suitable bulkhead on ends of pipe and on special openings to prevent drying out of lining. Bulkheads shall be substantial enough to remain intact during shipping and storage until pipe is installed.
5. Pipe shall be left bare where field joints occur.
6. Ends of lining shall be left square and uniform. Feathered or uneven edges will not be permitted.

C. Field-Applied:

1. Materials conforming to AWWA C602.
2. Do not use pozzolanic material in mortar mix.
3. Admixtures shall contain no calcium chloride.
4. Wire mesh conforming to AWWA C205.

2.09 CATHODIC PROTECTION

A. Provide as shown and as specified in Section 26 42 01, Pipe Bonding and Test Stations, and Section 26 42 02, Galvanic Anode Cathodic Protection System.

2.10 SOURCE QUALITY CONTROL

A. Crotch Plate:

1. Perform through-thickness tension testing with acceptance criteria per Article 5 of ASTM A770/A770M on each plate.
2. Conduct straight-beam ultrasonic examination with acceptance criteria per Article 6 of ASTM A435/A435M on each plate.
3. Plates that do not qualify shall not be used.

B. Shop Hydrostatic Pressure Test: In accordance with AWWA C200, except as follows:

1. General: Unless specified otherwise, testing of pipe and fittings shall be performed before lining and coating is applied.
2. Pipe: Maintain test pressure for minimum of 5 minutes.
3. Fittings:
   a. Except as otherwise specified herein, no additional shop hydrostatic test will be required on fittings fabricated from successfully tested straight pipe.
   b. Test fittings with crotch plates, regardless of whether or not straight pipe sections used were previously tested.

C. Joints, Lap-Welded:

1. Fit test minimum of five joints, selected by Engineer, of each pipe size used:
   a. Join pipe ends with proposed adjacent pipe end.
   b. Match-mark pipe ends.
   c. Record Actual Annular Space:
      1) Maximum space at a point.
      2) Minimum space at a point.
      3) Space at 90-degree intervals; top, bottom, and spring line on both sides.

D. Shop Nondestructive Testing:

1. Welds: 100 percent visually examined by Contractor's Shop Inspector to criteria in ASME BPVC SEC VIII, Division 1.
2. CJP Welds: Spot radiographically or radioscopically examine pipe in accordance with ASME BPVC SEC VIII, Division 1, Paragraph UW-52. Welds that, in opinion of Engineer, cannot readily be radiographed, shall be ultrasonically examined in accordance with paragraph UW-53.
3. Fillet Welds: 100 percent examine using magnetic particle inspection method in accordance with ASME BPVC SEC VIII, Division 1, Appendix 6.
4. Air test collars and wrappers in accordance with AWWA C206.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Joints and related work for field assembly of fittings shall conform to requirements for straight pipe, unless otherwise shown.
2. Inspect pipe and fittings before installation. Clean ends thoroughly, remove foreign matter and dirt from inside.
3. Make minor field adjustments by pulling standard joints.
   a. Maximum Allowable Angle: 75 percent of manufacturer's recommended or angle which results from 3/4-inch pull out from normal joint closure, whichever is less.
   b. Maximum Allowable Gap: 1/8 inch between bell and spigot at weld location.
4. Horizontal deflections or fabricated angles shall fall on alignment, as shown within tolerances below.

5. Vertical deflections shall fall on alignment, and pipe angle point locations shall match those indicated on Drawings within tolerances below.
6. For Field-welded Joints, Pipe 30 Inches in Diameter and Larger:
    a. Ensure maximum penetration of spigot end into bell end is achieved through use of shop-welded tabs on inside circumference of bell end or by use of a paint stripe.
    b. If welded metal tabs are used, remove tabs prior to welding inside of joint.
7. Stulling:
    a. Maintain stulling in place until pipe is completely backfilled and compacted.
    b. Reinstall stulls that were temporarily removed to facilitate interior welding prior to backfilling.
8. Pipeline Alignment Tolerances: As specified in Section 33 05 01, Conveyance Piping—General.

B. Control of Temperature Stresses:

1. In accordance with AWWA C206, approved Temperature Stress Control Plan submittal, and this Specification.
2. To control temperature stresses, shade unbackfilled special temperature control joint area of pipe from direct rays of sun by use of properly supported awnings, umbrellas, tarpaulins or other suitable materials until pipe is backfilled at least 1 foot over top of pipe. The special temperature control joint area is defined as the entire length of pipe left exposed. Shading materials shall not rest directly on pipe, but shall be supported to allow air circulation around pipe. Shading of special temperature control joints is not required when ambient air temperature is below 50 degrees F.
3. Locate special temperature control joints at 300-foot intervals.
4. Install special temperature control joints as indicated on Drawings.
5. Design, furnish and install a pipeline temperature monitoring system consisting of thermocouple temperature gauges to monitor temperature of steel pipe wall in trench. Gauges shall be located at top inside surface of pipe at intervals not exceeding 50 feet. Hand held portable temperature sensor devices may be used, provided temperature readings are taken at top of pipe at a frequency and spacing that demonstrates compliance with temperature control requirements.
6. Temperature Control Requirements:
    a. Prior to and during placement of pipe backfill, pipeline steel temperature shall be at or below 90 degrees F. Monitor specified temperature and control for at least 3 hours after placement of pipe backfill. Provide supplemental cooling as required.

b. Place pipe backfill from a single heading starting at one special temperature control joint and proceed toward next special temperature control joint.
c. During period of pipe backfill placement, pipeline section that is partially backfilled shall be shaded as indicated in above. Temperature of partially backfilled pipe shall not be allowed to exceed 90 degrees F. Provide supplemental cooling as required.
d. Prior to welding special temperature control joints, pipeline extending 300 feet each direction from joint shall be maintained at or below 70 degrees F. Additionally, pipeline extending 300 feet each direction from joint shall be backfilled to at least 1 foot over top of pipe. Weld special temperature control joint at specified temperature of 70 degrees or below. Begin and complete weld during coolest time interval of the 24-hour day. Use pipeline temperature monitoring system data to demonstrate to Engineer coolest interval of the day.
e. After field welding of special temperature control joint, pipe temperature for 150 feet in each direction shall be maintained below 90 degrees F for a minimum of 24 hours after special temperature control joint area has been backfilled to at least 1 foot over top of pipe.

3.02 WELDING

A. Perform welding only in presence of Contractor's Field Inspector.

B. Conform to AWS D1.1/D1.1M, AWWA C206, approved welding procedures, and referenced welding codes. In case of conflict AWS D1.1/D1.1M shall govern.

C. Preheat and Interpass temperature requirements for unlisted base metals shall be determined according to AWS D1.1/D1.1M, Annex XI Guideline on Alternative Methods for Determining Preheat.

D. Rejectable weld defects shall be repaired or redone, and retested until sound weld metal has been deposited in accordance with appropriate welding codes.

3.03 REPAIR OF SHOP-APPLIED COATINGS

A. Repair shop applied coatings as specified in Section 09 90 00, Painting and Coating, and Section 09 97 13, Pipeline Tape Coating.

3.04 COATING OF FIELD-WELDED JOINTS

A. As specified in Section 09 97 13, Pipeline Tape Coatings.

3.05 FIELD-APPLIED CEMENT-MORTAR LINING

A. General:

1. Except for requirements specified in this section, lining of steel pipe shall be in accordance with AWWA C602.
2. After joints are welded, air tested, and coated, and bedding and backfill have been placed, begin cleaning and lining operation with approval of Engineer. Access for cleaning and lining operations shall be at pipe access manholes or pipe ends. No cutting of openings in pipe will be allowed, unless approved in writing by Engineer.
3. Internal Cleaning:
    a. Prior to placing lining, pipe shall be thoroughly cleaned of foreign matter, including water.
    b. Cleaning may be by hand or mechanical method that is approved by Engineer.
    c. Waste materials and water from cleaning operations shall not be passed through sections of existing pipe or pipe that has already been lined.
    d. No pipe shall be lined until inspected and approved by Engineer.
4. Protection of Appurtenances:
    a. Prevent mortar from being thrown into pipe openings in accordance with AWWA C602.
    b. Outlet openings shall be trimmed, smoothed, and beveled.
    c. Damaged or defective areas shall be repaired to satisfaction of Engineer.

3.06 CEMENT-MORTAR LINING APPLICATION AT JOINTS

A. Cement-Mortar Lining: For pipe with shop-applied cement-mortar lining, place lining at joints in accordance with AWWA C205.

3.07 CATHODIC PROTECTION

A. Apply to pipe as shown and as specified in Section 26 42 02, Galvanic Anode Cathodic Protection System.

3.08 FIELD QUALITY CONTROL

A. Field Welding:

1. All welds, 100 percent inspection, shall be VT inspected by Contractor’s Field Inspector for Field Welding (CWI) and marked to indicate acceptance or rejection.

2. Test butt-strap or double-welded lap joint welds by pressurizing connection between the two fillet welds in accordance with AWWA C206.
    a. Apply air or other Engineer-approved gas into connection between the two fillet welds.
    b. Paint welds with soap solution.
    c. Mark leaks indicated by escaping gas bubbles.
    d. Close threaded openings with flush pipe plugs or by welding them.
3. CJP Welds:
    a. Inspect 10 percent of butt joint welds with full circumference RT.
    b. Inspect 10 percent of other groove welds with UT.
4. Inspect 10 percent of lap joint welds with PT or MT.
5. Weld Acceptance:
    a. If, in the opinion of Engineer, inspections indicate inadequate quality of welds, percentage of welds inspected shall be increased.
    b. Welds to be inspected, if less than 100 percent rate, shall be selected at random by Engineer.
    c. VT: Perform VT per AWS D1.1/D1.1M Paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.
    d. UT: Perform UT of CJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 6.13.1.
    e. RT: Perform RT of CJP butt joint welds in accordance with AWS D1.1/D1.1M, Paragraph 6.12.1.
    f. PT or MT:
        1) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 6.10.
        2) Acceptance shall be in accordance with VT standards specified above.
    g. Remove in manner that permits proper and complete repair by welding.
    h. Caulking or peening of defective welds is not permitted.
    i. Retest unsatisfactory welds.
6. Verification Acceptance: Owner or Engineer may conduct random nondestructive inspections of field-welded joints. Inspections will be of an appropriate type for weld being evaluated. Possible types of inspection include, but are not limited to, RT, UT, PT, and VT. Testing will be performed and evaluated per AWS D1.1/D1.1M. Provide Owner’s Verification Inspector access to the Work.

B. Hydrostatic Testing:

1. Pipeline:
   a. General:
      1) Notify Engineer in writing 5 days prior to testing. Perform testing in presence of Engineer.
      2) Test newly installed pipelines. Using water as test medium, pipes shall successfully pass a leakage test prior to acceptance.
      3) Furnish testing equipment and perform tests in manner satisfactory to Engineer. Testing equipment shall provide observable and accurate measurements of make-up water under specified conditions.
      4) Isolate new pipelines that are connected to existing pipelines.
      5) Conduct field hydrostatic test on buried piping after trench has been completely backfilled. Testing may, as approved by Engineer, be done prior to placement of asphaltic concrete or roadway structural section.
      6) Contractor may, if field conditions permit and as determined by Engineer, partially backfill trench and leave joints open for inspection and conduct an initial service leak test. Final field hydrostatic test shall not, however, be conducted until backfilling has been completed as specified above.
      7) Supply of temporary water shall be as stated in Section 01 50 00, Temporary Facilities and Controls.
      8) Dispose of water used in testing in accordance with federal, state, and local requirements.
   b. Procedure:
      1) Maximum filling velocity shall not exceed 0.25 foot per second, calculated based on the full area of pipe.
      2) Expel air from pipe system during filling. Expel air through air release valve or through corporation stop installed at high points and other strategic points.
      3) Test Pressure: As specified in Section 40 80 01, Piping Leakage Testing.
      4) Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.
      5) Maintain hydrostatic test pressure continuously for 4 hours minimum, adding additional make-up water only as necessary to restore test pressure.
      6) Determine actual make-up water by measuring quantity of water necessary to maintain specified test pressure for duration of test.

7) If measured make-up water exceeds allowable or if leaks are visible, repair defective pipe section and repeat hydrostatic test.

c. Allowable Make-up Water: For pipe with welded and flanged joints, no make-up water is allowed.

3.09 MANUFACTURER'S SERVICES

A. Manufacturer's representative available at Site for installation assistance and training of pipe installation crews.

1. Coordinate pipe manufacturer's representative services.
2. Pipe manufacturer's representative shall visit Site and instruct, guide, and provide procedures for pipe handling, laying, and jointing at start of pipe installation by each crew.

END OF SECTION

SECTION 33 05 01.02
DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): T99, Standard Method of Test for the Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop.
2. American Society of Mechanical Engineers (ASME):
   a. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
   b. B16.42, Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300.
3. American Water Works Association (AWWA):
   a. C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
   b. C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.
   c. C110/A21.10, Ductile-Iron and Gray-Iron Fittings.
   d. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   e. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Fittings.
   f. C116/A21.16, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
   g. C150/A21.50, Thickness Design of Ductile-Iron Pipe.
   h. C151/A21.51, Ductile-Iron Pipe. Centrifugally Cast, for Water.
   i. C153/A21.53, Ductile-Iron Compact Fittings for Water Service.
   j. C600, Installation of Ductile-Iron Water Mains and Their Appurtenances.
   k. C606, Grooved and Shouldered Joints.
4. ASTM International (ASTM):
   a. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
   b. A563, Standard Specification for Carbons and Alloy Steel Nuts.
   c. D882, Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
   d. D1330, Standard Specification for Rubber Sheet Gaskets.

e. D1922, Standard Test Method for Propagation Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Method.
f. D2000, Standard Classification System for Rubber Products in Automotive Applications.
g. D4976, Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.

5. International Organization for Standardization (ISO): 9001, Quality Management Systems – Requirements.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Marking plan and details of standard pipe section showing dimensions, pipe joints, fitting and special fitting pressure rating and thickness, size, coating and lining data.

B. Informational Submittals:

1. Manufacturer’s Certificate of Compliance stating that inspections and specified tests have been made and that results thereby comply with requirements of Article Source Quality Control.
2. Field Hydrostatic Testing Plan: Submit at least 15 days prior to testing and at minimum, include the following:
   a. Testing dates.
   b. Piping systems and section(s) to be tested.
   c. Method of isolation.
   d. Method of conveying water from source to system being tested.
   e. Calculation of maximum allowable leakage for piping section(s) to be tested.
3. Certifications of Calibration: Approved testing laboratory certificate if pressure gauge for hydrostatic test has been previously used. If pressure gauge is new, no certificate is required.
4. Test documentation form and results.

1.03 QUALITY ASSURANCE

A. Pipe manufacturer shall be ISO 9001 registered or provide the services of an independent inspection agency.

B. Prior to start of manufacturing, manufacturer not meeting or having ISO registration requirements shall submit name of at least two independent inspection agencies for approval. Independent inspection agency shall be responsible, on a daily basis, for sample monitoring of chemical and mechanical tests, sample visual inspection of quality assurance tests performed on in-process pipe and fittings, and sample visual and dimensional inspection on finished products.

PART 2 PRODUCTS

2.01 MATERIALS

A. General:

1. Ductile iron pipe shall be manufactured, lined, coated, and tested domestically in the United States of America.
2. Pipe manufacturer shall certify source manufacturing facility has been producing ductile iron pipe of the specified diameters, pressure, dimensions and standards for a period of not less than 10 years.
3. Ductile iron pipe and fitting shall be supplied by a single manufacturer.
    a. Mixing of components and sources is not permitted.
    b. Fitting from outside the United States of America shall be produced in a facility with a minimum of 5 years' documented experience manufacturing, coating, testing, and delivery of size and type specified to projects in the United States of America.

B. Pipe:

1. General:
    a. Pipe shall be new and recently manufactured. Refurbished pipe shall not be provided.
    b. Lined and coated as specified.
2. Meet requirements of AWWA C150/A21.50, AWWA C151/A21.51, and AWWA C111/A21.11.
3. Centrifugally cast, grade 60-42-10 iron.
4. Pressure rating of pipe shall be a minimum of 250 psi.
5. Pipe wall thickness of threaded pipe for a flanged pipe end shall be in accordance with AWWA C115/A21.15.
6. Grooved end pipe shall be minimum Special Class 53.

C. Joints:

1. Push-On Joint: Rated at minimum working pressure equal to pipe material design.

2. Restrained Joint:
   a. Manufactured proprietary joint that mechanically restrains pipe to adjoining pipe.
   b. Manufacturers and Products:
      1) American Cast Iron Pipe; Flex-Ring, Field Flex-Ring, and Lok-Ring.
      2) Pacific States Pipe; Thrust-Lock.
      3) U.S. Pipe; TR Flex and HP Lok.
3. Mechanical Wedge Action Type Joint:
   a. Use only in areas where adjoining to fixed points where laying length is determined in field.
   b. Prior to purchase and installation, type and application of this joint shall be approved by Engineer.
4. Use of set screws for restraint or field-lock gaskets shall not be allowed.
5. Grooved Joint:
   a. Rigid type radius cut grooved, conforming to AWWA C606.
   b. Manufacturer: Victaulic Company of America.
6. Ball Joint:
   a. Meet requirements of AWWA C151/A21.51.
   b. Minimum Working Pressure:
      1) 4-inch through 12-inch Diameter: 350 psi.
      2) Larger than 12-inch Diameter: 250 psi.
   c. Manufacturers and Products:
      1) American Cast Iron Pipe; Flex-Lock.
      2) U.S. Pipe; USIFLEX.

D. Fittings:

1. Fittings shall be new and recently manufactured. Refurbished fittings will not be accepted.
2. Mechanical, Push-On, Flanged, or Restrained Joint: In accordance with the following table:

Minimum Pressure Ratings for AWWA C110/A21.10 and C115/A21.15 Ductile Iron Fittings		
Diameter (inches)	**Rubber Gasket Joints (Push-on, Mechanical, Restrained) (psi)**	**Flanged Joints (psi)**
3 to 24	350	250

Minimum Pressure Ratings for AWWA C153/A21.53 Ductile Iron Fittings		
Diameter (inches)	**Rubber Gasket Joints (Push-on, Mechanical, Restrained) (psi)**	**Flanged Joints**
3 to 24	350	Not included in C153/A21.53 (refer to the C110/A21.10 Standard)

3. Rubber Gasket Joints Including Mechanical Joints, Push-On Joints, and Flanged Joints: In accordance with AWWA C111/A21.11.
4. Mechanical Joint Fittings: In accordance with AWWA C110/A21.10 and AWWA C153/A21.53.
5. Grooved End Fittings:
   a. Radius cut grooved, rigid type conforming to AWWA C110/A21.10 and AWWA C153/A21.53.
   b. Manufacturers:
      1) Victaulic Company of America.
      2) Gustin-Bacon.

E. Welded Outlet: Only weld to pipe in manufacturer's shop.

F. Lining: Pipe and fittings for clean water applications shall be cement-lined and asphaltic seal coated as recommended by manufacturer in accordance with AWWA C104/A21.4.

G. Coating: Asphaltic type, 1 mil thick, in accordance with AWWA C151/ A21.51, AWWA C115/A21.15, AWWA C110/A21.10, and AWWA C153/ A21.53.

H. Polyethylene Encasement:

1. Virgin polyethylene raw material conforming to requirements of ASTM D4976.
2. Elongation: 800 percent, minimum, in machine and transverse direction (ASTM D882).
3. Tensile Strength: 3,600 psi, minimum.
4. Dielectric Strength: 800V per mil-thickness, minimum.
5. Propagation Tear Resistance: 2,550-gram force (gf), minimum, in machine and transverse direction (ASTM D1922).
6. Tube Form: Conform to AWWA C105/A21.5.
7. Film: 0.008 inch (8 mil) thick, minimum.
8. Number of Film Layers: One.

I. Bolting:

1. Flanged Connection Bolts: Carbon steel, ASTM A307, Grade A hex bolts and ASTM A563, Grade A hex head nuts.
2. Grooved End Connections Bolts: Manufacturer's standard.

J. Gaskets:

1. Flat Faced Flange Gaskets:
   a. Pipe Smaller Than 54 Inches: Rated for working pressure 150 psi to 250 psi, 1/8 inch thick, red rubber (SBR), hardness 80 (Shore A), rated to 200 degrees F, conforming to ASME B16.21, AWWA C207, and ASTM D1330, Grade 1 and Grade 2.
   b. Pipe 54 Inches and Larger: Rated for working pressure greater than 250 psi; shall be Toruseal gaskets as manufactured by American Ductile Iron Pipe or Flange-Tyte gaskets as manufactured by U.S. Pipe.
2. Grooved End Joint Gaskets: Halogenated butyl, conforming to ASTM D2000 and AWWA C606.

2.02 SOURCE QUALITY CONTROL

A. Factory Tests:

1. General:
   a. Tests shall be performed on pipe with metal thickness equal to that specified.
   b. Only pipe that passes leak test shall be shipped.
2. Hydrostatic Proof Test:
   a. All Pipe: Perform at 500 psi for a minimum duration of 10 seconds.
   b. Record each test cycle on a strip chart.
   c. Inspect each pipe during testing for leaks.
   d. Pipe which shows evidence of leaks shall be scrapped.
   e. Repair welding of leaks is not permitted.
3. Perform a 15-psi air test on welded-on outlet pipe.
4. Pipe ends (spigot end, bell and socket) shall be gauged with suitable gauges at sufficiently frequent intervals to ensure compliance to standard dimensions of AWWA C151/A21.51.
   a. In addition, each socket and spigot shall be inspected in a well-lit area for injurious defects which could affect the joint performance.
   b. Remove defects by cutting of pipe ends.
   c. Pipe with injurious defects in the bell shall be scrapped.

d. Manufacturer shall have a recommended ovality tolerance for pipes 18 inches inch and larger.
e. Each end of each 18-inch and larger pipe shall be measured and approved by manufacturer's quality assurance inspector to meet tolerances.

5. Submit a certified inspection report from the independent agency of witnessed tests within 10 days of the inspection. Test results shall show restrained joints in the sizes specified have been successfully tested to at least twice the specified pressure rating of the joint without leakage or failure.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect pipe and fittings to ensure no cracked, broken, or otherwise defective materials are being used.

3.02 PREPARATION

A. Trench Grade:

1. When specified, grade bottom of trench by hand to specified line and grade with proper allowance for pipe thickness and pipe base. Trench bottom shall form a continuous and uniform bearing and support for pipe between bell holes.
2. Before laying each section of pipe, check grade and correct irregularities found. Grade may be disturbed for removal of lifting tackle.

B. Pipe Bedding: Place and compact pipe bedding material as follows:

1. Install to full width of trench, from 6 inches below to 6 inches above the pipe.
2. Compact to at least 95 percent of its maximum density as determined by a Modified proctor.
3. Ensure that no unfilled or uncompacted areas occur beneath pipe.

C. Bell (Joint) Holes: At each joint, dig bell holes of ample dimensions in bottom of trench, and at sides where necessary, to permit joint to be made properly and to permit easy visual inspection of entire joint.

3.03 INSTALLATION

A. General:

1. Provide and use proper implements, tools, and facilities for safe and proper prosecution of the Work.
2. Lower pipe, fittings, and appurtenances into trench, piece by piece, by means of a crane, slings, or other suitable tools and equipment, in such a manner as to prevent damage to pipe materials, protective coatings and linings.
3. Do not drop or dump pipe materials into trench.

B. Cleaning Pipe and Fittings:

1. Remove lumps, blisters, and excess coal tar coating from bell and spigot ends of each pipe. Wire brush outside of spigot and inside of bell and wipe clean, dry, and free from oil and grease before pipe is laid.
2. Wipe ends of mechanical joint pipe and fittings and of rubber gasket joint pipe and fittings clean of dirt, grease, and foreign matter.

C. Laying Pipe:

1. Direction of Laying: Lay pipe with bell end facing in direction of laying. For lines on an appreciable slope, face bells upgrade at discretion of Engineer.
2. Mechanical Joint, Push-On Joint, and Restrained Joint Pipe: After first length of pipe is installed in trench, secure pipe in place with approved backfill material tamped under and along sides to prevent movement. Keep ends clear of backfill. After each section is jointed, place backfill as specified to prevent movement.
3. Take precautions necessary to prevent floating of pipe prior to completion of backfill operation.
4. When using movable trench shield, take necessary precautions to prevent pipe joints from pulling apart when moving shield ahead.
5. Do not allow foreign material to enter pipe while it is being placed in trench.
6. Close and block open end of last laid section of pipe to prevent entry of foreign material or creep of gasketed joints when laying operations are not in progress, at close of day’s work, or whenever workers are absent from job.

D. Joining Push-On Joint Pipe and Mechanical Joint Fittings:

1. Join pipe with push-on joints and mechanical joint fittings in accordance with manufacturer's recommendations.
2. Provide special tools and devices, such as, special jacks, chokers, and similar items required for installation.
3. Lubricate pipe gaskets using lubricant furnished by pipe manufacturer. No substitutes will be permitted.
4. Clean ends of fittings of dirt, mud, and foreign matter by washing with water and scrubbing with a wire brush, after which, slip gland and gasket on plain end of pipe. If necessary, lubricate end of pipe to facilitate sliding gasket in place, then guide fitting onto spigot of pipe previously laid.

E. Ball Joint Pipe:

1. Assemble and install in accordance with manufacturer's recommendations.
2. Hydrostatic Test:
   a. Conduct on ball joint pipe independent of other pipe systems/type being installed.
   b. Conduct test in accordance with requirements of these Specifications and manufacturer's recommendations.

F. Cutting Pipe:

1. General: Cut pipe for inserting valves, fittings, or closure pieces in a neat and workmanlike manner without damaging pipe or lining and so as to leave a smooth end, at right angles to axis of pipe.
2. Pipe: Cut pipe with milling type cutter or saw. Do not flame cut.
3. Dressing Cut Ends: Dress cut end of mechanical joint pipe to remove sharp edges or projections, which may damage rubber gasket. Dress cut ends of push-on joint pipe by beveling, as recommended by manufacturer.

G. Field Welding:

1. Use of field welded outlets will not be allowed. Welding for outlets shall be performed only in pipe manufacturer's shop.
2. Field installed outlets may be installed with saddle approved by Engineer. Opening in pipe shall be machined cut and not with cutting torch.
3. Field welding of bars for restrained joint systems will not be allowed. Welding shall be performed in pipe manufacturer's shop.

H. Line and Grade:

1. Minimum Pipe Cover: 3 feet, unless otherwise indicated.
2. No high points will be allowed between air valves.
3. Maintain pipe grade between invert elevations to provide minimum clearance at air valve locations of 4 feet from existing ground surface to top of pipe.
4. Install air valves as shown and field verify intervening low points. When field conditions warrant, exceptions may be made upon approval of Engineer.
5. Deviations exceeding 6 inches from specified line or 1 inch from specified grade will not be allowed without express approval of Engineer.
6. Pipeline sections that are not installed to elevations shown or installed as approved by Engineer shall be reinstalled to proper elevation.

I. Thrust Restraint: Primary method of restraint shall be through use of restrained joint pipe. Thrust blocking shall be used where detailed on Drawings and as approved by Engineer.

J. Backfill for Pipe Zone: Place and compact pipe zone material as follows:

1. After pipe bedding is in place, place imported granular material at approximately same rate on each side of pipe.
2. Place to the following depths:
   a. 6 inches above top of pipe barrel.

K. Polyethylene Encasement:

1. Encase pipe, fittings, and valves where specified in accordance with AWWA C105/A21.5, Method A.
2. Cut polyethylene tube approximately 2 feet longer than pipe length.
3. Slip tube around pipe, centering to provide 1-foot overlap on each adjacent section.
4. Pull encasement to take out slack and wrap snug around pipe.
5. Secure overlap in place and fold at quarter points of pipe length.
6. Wrap and tape encasement snug around fittings and valves.

L. Cathodic Protection, Joint Bonding, and Test Stations:

1. Cathodic protection shall conform to Section 26 42 02, Galvanic Anode Cathodic Protection System.
2. Joint bonds and test stations shall conform to Section 26 42 01, Pipe Bonding and Test Stations.

3.04 HYDROSTATIC TESTING

A. Pipeline Hydrostatic Test:

1. General:
   a. Notify Engineer in writing 3 days in advance of testing. Perform testing in presence of Engineer.
   b. Test newly installed pipelines. Using water as test medium, pipes shall successfully pass a leakage test prior to acceptance.
   c. Furnish testing equipment and perform tests in manner satisfactory to Engineer. Testing equipment shall provide observable and accurate measurements of leakage under specified conditions.
   d. Isolate new pipelines that are connected to existing pipelines.
   e. Conduct tests on entire pipeline after trench has been backfilled. Testing may be done prior to placement of asphaltic concrete or roadway structural section.
   f. Contractor may, if field conditions permit and as determined by Engineer, partially backfill trench and leave joints open for inspection and conduct an initial service leak test. Hydrostatic test shall not, however, be conducted until backfilling has been completed.
   g. Supply of temporary water shall be as stated in Section 01 50 00, Temporary Facilities and Controls.
   h. Dispose of water used in testing.
2. Procedure:
   a. Maximum filling velocity shall not exceed 0.25 foot per second, calculated based on the full area of pipe.
   b. Expel air from pipe system during filling. Expel air through air release valve or through corporation stop installed at high points and other strategic points.
   c. Test pressure shall be 50 psi above system operating pressure.
   d. Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.
   e. Maintain hydrostatic test pressure continuously for 2 hours minimum, adding additional make-up water only as necessary to restore test pressure.
   f. Determine actual leakage by measuring quantity of water necessary to maintain specified test pressure for duration of test.
   g. If measured leakage exceeds allowable leakage or if leaks are visible, repair defective pipe section and repeat hydrostatic test.
3. Allowable Leakage: Allowable leakage is zero.

END OF SECTION

SECTION 33 05 01.09
POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Specification applies to the small diameter PVC pipe used for incidental miscellaneous vault facilities.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
   a. C110, Ductile-Iron and Gray-Iron Fittings.
   b. C153, Ductile-Iron Compact Fittings, for Water Service.
   c. C605, Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
   d. C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 Inches Through 12 Inches (100 mm Through 300 mm), for Water Transmission and Distribution.
   e. C905, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 Inches through 48 Inches (350 mm through 1,200 mm) for Water Transmission and Distribution.
   f. C907, Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 Inches through 12 Inches (100 mm Through 300 mm), for Water, Wastewater, and Reclaimed Water Service.
2. ASTM International (ASTM):
   a. D2241, Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
   b. D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
   c. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
   d. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
   e. D2672, Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement.

f. D2855, Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
g. D3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

3. NSF International (NSF).

1.03 SUBMITTALS

A. Action Submittals: Drawings showing pipe diameter, pipe class, dimension ratio (DR) and fitting details.

B. Informational Submittals:

1. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
2. Hydrostatic Testing Plan: Submit at least 15 days prior to testing and at minimum, include the following:
   a. Testing dates.
   b. Piping systems and section(s) to be tested.
   c. Method of isolation.
   d. Method of conveying water from source to system being tested.
   e. Method of disposing of test water.
   f. Calculation of maximum allowable leakage for piping section(s) to be tested.
3. Certification of Calibration: Approved testing laboratory certificate if pressure gauge for hydrostatic test has been previously used. If pressure gauge is new, no certificate is required.
4. Test report documentation.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Solvent Cement: Store in accordance with ASTM D2855 and manufacturer recommendations.

PART 2 PRODUCTS

2.01 MATERIALS

A. Yard Piping 12-inch and smaller:

1. PVC, conforming to requirements of AWWA C900.
2. Pressure class as indicated on Drawings.
3. Non restrained pipe (at the joints) shall have thrust blocks at all fittings/bends 11.25-degree and larger. Thrust blocks sized per drawing details. All buried ductile fittings shall be wax tape coated.

B. Vent Piping and Sump Discharge Piping:

1. PVC, conforming to requirements of ASTM D1784 and ASTM D1785.
2. Pressure Class: Schedule 80, Type I, Grade I or Class 12454-B, or as shown on Drawings.
3. Pipe shall be manufactured with 2 percent titanium dioxide for ultraviolet protection.
4. Pipe to be used for potable water conveyance shall meet the requirements of NSF 61.
5. Threaded Nipples: Schedule 80 PVC.

C. Fittings:

1. Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket weld type and Schedule 80 ASTM D2464 for threaded type. Fittings shall be manufactured with 2 percent titanium dioxide for ultraviolet protection.

D. Joints:

1. Solvent welded except where connection to threaded valves and equipment may require future disassembly.
2. Socket type joints shall be made employing solvent cement that meets or exceeds the requirements of ASTM D2564 and primer that meets or exceeds requirements of ASTM F656, chemically resistant to the fluid service, and as recommended by pipe and fitting manufacturer, certification shall be submitted. Solvent cement and primer shall be listed by NSF 61 for contact with potable water.

E. Flanges: One piece, molded hub type PVC flat face flange in accordance with fittings above, 125-pound ANSI B16.1 drilling.

F. Bolting: As specified in Section 33 05 01, Conveyance Piping—General.

G. Gaskets:

1. Flat Face Mating Flange: Full faced 1/8-inch thick ethylene propylene (EPR) rubber.
2. Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EPR) rubber, with filler gasket between OD of raised face and flange OD to protect the flange from bolting movement.

H. Thread Lubricant: Teflon tape.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.
2. Remove foreign objects prior to assembly and installation.
3. Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
4. Use strap wrench for tightening threaded plastic joints. Do not over tighten fittings.
5. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
6. Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.
7. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.

B. Flanged Joints:

1. Install perpendicular to pipe centerline.
2. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.
3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.
4. Install annular ring filler gasket at joints of raised-face flange.
5. Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast iron flange.

END OF SECTION

SECTION 33 05 13
MANHOLES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): M198, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
2. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A48/A48M, Standard Specification for Gray Iron Castings.
   c. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   d. A536, Standard Specification for Ductile Iron Castings.
   e. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   f. B139/B139M, Standard Specification for Phosphor Bronze Rod, Bar, and Shapes.
   g. C14, Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.
   h. C31/C31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   i. C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   j. C150/C150M, Standard Specification for Portland Cement.
   k. C192/C192M, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
   l. C387/C387M, Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
   m. C443, Standard Specification for Joints for Concrete Pipe and Manholes Using Rubber Gaskets.
   n. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
   o. C923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
   p. C990, Standard Specification for Joints in Concrete Pipe, Manholes, and Precast Box Sections using Preformed Flexible Joint Sealants.
   q. C1311, Standard Specification for Solvent Release Sealants.

r. C1244, Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
s. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
t. D4101, Standard Specification for Propylene Injection and Extrusion Materials.
u. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
v. F594, Standard Specification for Stainless Steel Nuts.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings including details of construction, reinforcing and joints, anchors, lifting, erection inserts, and other items cast into members.
2. Product Data:
   a. Concrete mix design.
   b. Manhole frame to structure seals.
   c. Manhole frame to structure anchor bolt.
   d. Rubber gaskets and sealants.
   e. External joint wrap.

B. Informational Submittals:

1. Experience Record:
   a. Precast concrete production capabilities.
   b. Evidence of current PCI plant certification.
2. Certificate of Compliance: Certify admixtures and concrete do not contain calcium chloride.
3. Manufacturer’s recommended installation instructions.
4. Field quality control report.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Precast Concrete and Precast Prestressed Concrete: Product of manufacturer with 3 years’ experience producing precast concrete products of quality specified.
2. Precast Plant: PCI certified plant with current certification.

PART 2 PRODUCTS

2.01 GENERAL

A. Materials of Construction and Service Conditions:

1. Screws, Bolts, or Nuts: Type 304 stainless steel conforming to ASTM F593 and ASTM F594.
2. Gaskets: Internal and external seals shall be made of materials that have been proven to be resistant to the following exposures and conditions:
   a. Sanitary sewage.
   b. Corrosion or rotting under wet or dry conditions.
   c. Gaseous environment in sanitary sewers and at road surfaces including common levels of ozone, carbon monoxide, and other trace gases at installation site.
   d. Biological environment in soils and sanitary sewers.
   e. Chemical attack by road salts, road oil, and common street spillages or solvents used in street construction or maintenance.
   f. Temperature ranges, variations, and gradients in construction area.
   g. Variations in moisture conditions and humidity.
   h. Fatigue failure caused by a minimum of 30 freeze-thaw cycles per year.
   i. Vibrations because of traffic loading.
   j. Fatigue failure because of repeated variations of tensile, compressive and shear stresses, and repeated elongation and compression. Material shall remain flexible allowing repeated movement.
3. Materials shall be compatible with each other and manhole materials.
4. Designed to provide a 20-year service life.

B. Structures shall meet requirements of ASTM C478, this Specification and the following:

1. Concrete:
   a. Cement: Meet requirements of ASTM C150/C150M.
   b. Compressive Strength:
      1) Minimum 4,000 psi.
      2) Minimum strength shall be confirmed at 7 days by making two standard cylinders per manhole for testing.
2. Reinforcement: Grade 60, unless otherwise specified.
3. Ring: Custom made with openings to meet indicated pipe alignment conditions and invert elevations.
4. Floor: Minimum 3 inches below pipe to provide clearance for grouting channels.

5. Joint:
    a. Form joint contact services with machined castings.
    b. Surfaces shall be parallel with nominal 1/16-inch clearing and tongue equipped with recess for installation of O-ring rubber gasket.
6. Gasket: Meet requirements of ASTM C443.

2.02 PRECAST MANHOLES

A. Riser Sections:

1. Fabricate in accordance with ASTM C478.
2. Diameter: As shown on Drawings.
3. Wall Thickness: Minimum 4 inches or 1/12 times inside diameter, whichever is greater.
4. Top and bottom surfaces shall be parallel.
5. Joints: Tongue-and-groove.

B. Cone Sections:

1. Eccentric.
2. Same wall thickness and reinforcement as riser section.
3. Top and bottom surfaces shall be parallel.

C. Base Sections and Base Slab:

1. Base slab integral with sidewalls.
2. Fabricate in accordance with ASTM C478.

D. Manhole Extensions:

1. Concrete grade rings; maximum 6 inches high.
2. Fabricate in accordance with ASTM C478.

E. Joint Seal Manufacturers and Products:

1. Butyl Gaskets:
    a. Hamilton Kent, Sparks, NV; Kent-Seal No. 2.
    b. Henry Company, Houston, TX; Ram-Nek.
    c. Trelleborg Engineered Solutions, Park Hills, MO; NPC Bidco C-56.
2. Confined Plastic or Rubber O-Ring:
    a. As recommended by precasting manufacturer.
    b. Meet requirements of ASTM C443.

3. External Wrap:
    a. Sealing Systems, Inc., Loretto, MN; Gator Wrap.
    b. Henry Company, Houston, TX; RU116 Rubr-Nek External Joint Wrap.
    c. Trelleborg Engineered Solutions, Park Hills, MO; NPC External Joint Wrap.
    d. Cretex Specialty Products, Waukesha, WI; Cretex Wrap.

F. Polypropylene Steps:

1. Fabricate from minimum 1/2-inch, Grade 60, steel bar meeting ASTM A615/A615M.
2. Polypropylene encasement shall conform to ASTM D4101.
3. Minimum Width: 13 inches, center-to-center of legs.
4. Embedment: 3-1/2-inch minimum and 4-1/2-inch minimum projection from face of concrete at point of embedment to center of step.
5. Cast in manhole sections by manufacturer.
6. Load Test: Capable of withstanding ASTM C478 vertical and horizontal load tests.

2.03 MANHOLE FRAMES AND COVER

A. Castings:

1. Tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and defects.
2. Cast Iron: ASTM A48/A48M Class 30B.
3. Ductile Iron: ASTM A536, Grade 60-40-12.
4. Plane or grind bearing surfaces to ensure flat, true surfaces.

B. Cover: With the words STORM DRAIN or WATER as appropriate in 2-inch raised letters.

2.04 MANHOLE FRAME CONNECTION TO STRUCTURE

A. Butyl Sealant:

1. Conform to ASTM C1311, or AASHTO M198 and ASTM C990.
2. Trowelable or cartridge applied.
3. Manufacturers and Products:
    a. Tremco Commercial Sealants and Waterproofing, Beachwood, OH; Tremco Butyl Sealant.
    b. Bostik, Middleton, MA; Chem-Calk 300.
    c. Press-Seal Gasket Company, Fort Wayne, IN; EZ-Stik #3.

2.05 MORTAR

A. Standard premixed in accordance with ASTM C387/C387M, or proportion one part Portland cement to two parts clean, well-graded sand that will pass a 1/8-inch screen.

B. Admixtures:

1. May be included; do not exceed the following percentages of weight of cement:
   a. Hydrated Lime: 10 percent.
   b. Diatomaceous Earth or Other Inert Material: 5 percent.

C. Mix Consistency:

1. Tongue-and-Groove Type Joint: Such that mortar will readily adhere to pipe.
2. Confined Groove (Keylock) Joint: Such that excess mortar will be forced out of groove and support is not provided for section being placed.

2.06 BACKFILL AROUND AND UNDER MANHOLE

A. Structural fill as specified in Section 31 23 23, Fill and Backfill.

PART 3 EXECUTION

3.01 GENERAL

A. Prior to installation inspect materials:

1. Sections not meeting requirements of this Specification or that are determined to have defects which may affect durability of structure are subject to rejection.
2. Sections damaged after delivery will be rejected and if already installed shall be repaired to satisfaction of Owner and Engineer.
3. Remove and replace structure that cannot be repaired.

B. If needed, dewater excavation during construction and testing operations.

3.02 EXCAVATION AND BACKFILL

A. Excavation: As specified in Section 31 23 16, Excavation.

B. Backfill:

1. As specified in Section 31 23 23, Fill and Backfill.
2. Place structural fill under manhole in 6-inch maximum lifts; minimum of 12 inches unless otherwise specified on Drawings.

3.03 INSTALLATION OF PRECAST MANHOLES

A. Concrete Base:

1. Precast:
   a. Place on compacted structural fill.
   b. Properly locate, ensure firm bearing throughout, and plumb first section.

B. Sections:

1. Inspect precast manhole sections to be joined.
2. Clean ends of sections to be joined.
3. Do not use sections with chips or cracks in tongue.
4. Locate precast steps in line with each other to provide continuous vertical ladder.

C. Preformed Plastic Gaskets or Rubber O-Ring:

1. Use only pipe primer furnished by gasket manufacturer.
2. Install gasket material in accordance with manufacturer’s instructions.
3. Completed Manhole: Rigid and watertight.

D. Extensions:

1. Provide on manholes in streets or other locations where change in existing grade may be likely.
2. Install to height not exceeding 12 inches.
3. Lay grade rings in mortar with sides plumb and tops level.
4. Seal joints with mortar as specified for sections and make watertight.

3.04 MANHOLE INVERT

A. Construct with smooth transitions to ensure unobstructed flow through manhole. Remove sharp edges or rough sections that tend to obstruct flow.

B. Where full section of pipe is laid through manhole, break out top section and cover exposed edge of pipe completely with mortar. Trowel mortar surfaces smooth.

3.05 MANHOLE FRAMES AND COVERS

A. Install concrete grade rings as required to set covers flush with surface of adjoining pavement or ground surface, unless otherwise shown or directed.

B. Set frames in three equally spaced beads of butyl sealant that run full circumference of frame.

C. Anchor frame to manhole with specified bolts.

3.06 MANHOLE PIPING

A. Flexible Joints:

1. Provide in pipe not more than 1-1/2 feet from manhole walls.
2. Where last joint of pipe is between 1-1/2 feet and 6 feet from manhole wall, provide flexible joint in manhole wall.

3.07 FIELD QUALITY CONTROL

A. Hydrostatic Testing:

1. Hydrostatically test all manholes. Plug outlet and fill manhole up to 4 feet above invert and observe the water level for 4 hours.
2. Manhole may be filled 24 hours prior to time of testing, if desired, to permit normal absorption into pipe walls to take place.
3. Leakage in each manhole shall not exceed 0.1 gallon per hour per foot of head above invert.
4. Repair manholes that do not meet leakage test, or do not meet specified requirements from visual inspection.

END OF SECTION

SECTION 33 13 00
DISINFECTION OF WATER UTILITY DISTRIBUTION FACILITIES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
   a. B300, Hypochlorites.
   b. B301, Liquid Chlorine.
   c. B302, Ammonium Sulfate.
   d. B303, Sodium Chlorite.
   e. C651, Disinfecting Water Mains.
   f. C652, Disinfection of Water Storage Facilities.
   g. C653, Disinfection of Water Treatment Plants.
2. NSF International (NSF):
   a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
   b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
3. Standard Methods for the Examination of Water and Wastewater, as published by American Public Health Association, American Water Works Association, and the Water Environment Federation.

1.02 SUBMITTALS

A. Informational Submittals:

1. Plan describing and illustrating conformance to appropriate AWWA standards and this Specification.
2. Procedure and plan for cleaning system.
3. Procedures and plans for disinfection and testing.
4. Proposed locations within system where Samples will be taken.
5. Type of disinfecting solution and method of preparation.
6. Method of disposal for highly chlorinated disinfecting water.
7. Independent Testing Agency: Certification that testing agency is qualified to perform chlorine concentration testing, and bacteriological testing in accordance with AWWA standards, State of Utah requirements, and this Specification.
8. Certified Bacteriological Test Results:
   a. Facility tested is free from coliform bacteria contamination.
   b. Forward results directly to Owner and Engineer.

1.03 QUALITY ASSURANCE

A. Independent Testing Agency: Certified in the State of Utah, with 10 years' experience in field of water sampling and testing. Agency shall use calibrated testing instruments and equipment and documented standard procedures for performing specified testing.

1.04 SEQUENCING

A. Commence initial disinfection after completion of following:

1. Hydrostatic and pneumatic testing, pressure testing, functional and performance testing and acceptance of pipelines, pumping systems, structures, and equipment.

PART 2 PRODUCTS

2.01 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 WATER FOR DISINFECTION AND TESTING

A. Clean, uncontaminated, and potable.

B. The Owner will contribute a total of 10MG of water for testing. Contractor shall obtain by his own means any additional water required for disinfection and hydro static testing and make arrangements to supply and convey water in the disinfected pipelines. Contractor is responsible to pay for any additional water that may be required in the event of a failed hydraulic test.

PART 3 EXECUTION

3.01 GENERAL

A. Conform to AWWA C652 for reservoirs, and AWWA C651 for pipes and pipelines, except as modified in these Specifications.

B. Contractor's Equipment:

1. Furnish chemicals and equipment, such as pumps and hoses, to accomplish disinfection.
2. Water used to fill pipeline may be supplied using a temporary connection to existing distribution system. Provide protection against cross-connections as required by AWWA C651.

C. Disinfect the following items installed or modified under this Project, intended to hold, transport, or otherwise contact potable water:

1. Reservoirs: Disinfect new reservoirs independently before making any connections to another source.
2. Pipelines: Disinfect new pipelines that connect to existing pipelines up to point of connection.
3. Disinfect surfaces of materials that will contact finished water, both during and following construction, using one of the methods described in AWWA C652 and AWWA C653. Disinfect prior to contact with finished water. Take care to avoid recontamination following disinfection.

D. Prior to application of disinfectants, clean pipelines of loose and suspended material.

E. Allow freshwater and disinfectant solution to flow into pipe or vessel at a measured rate so chlorine-water solution is at specified strength. Do not place concentrated liquid commercial disinfectant in pipeline or other facilities to be disinfected before it is filled with water.

3.02 TURBIDITY

A. Cleaning of equipment and facilities shall include removal of materials that result in a turbidity exceeding limits stated in Article Testing.

3.03 PIPELINES

A. Cleaning:

1. Before disinfecting, clean foreign matter from pipe in accordance with AWWA C651.
2. If continuous feed method or slug method of disinfection, as described in AWWA C651, are used flush pipelines with potable water until clear of suspended solids and color. Provide hoses, temporary pipes, ditches, and other conduits as needed to dispose of flushing water without damage to adjacent properties.
3. Flush service connections and hydrants. Flush distribution lines prior to flushing hydrants and service connections. Operate valves during flushing process at least twice during each flush.
4. Flush pipe through flushing branches and remove branches after flushing is completed.

B. Disinfecting Procedure: In accordance with AWWA C651, unless herein modified.

3.04 DISPOSAL OF CHLORINATED WATER

A. Do not allow flow into a waterway without neutralizing disinfectant residual.

B. See appendix of AWWA C651 for acceptable neutralization methods.

3.05 TESTING

A. Collection of Samples:

1. Coordinate activities to allow Samples to be taken in accordance with this Specification.
2. Provide valves at sampling points.
3. Provide access to sampling points.

B. Test Equipment:

1. Clean containers and equipment used in sampling and make sure they are free of contamination.
2. Obtain sampling bottles with instructions for handling from Owner’s laboratory.

C. Chlorine Concentration Sampling and Analysis: Collect and analyze Samples in accordance with AWWA C651.

D. After pipelines have been cleaned, disinfected, and refilled with potable water.

E. If minimum Samples required above are bacterially positive, disinfecting procedures and bacteriological testing shall be repeated until bacterial limits are met.

END OF SECTION

SECTION 33 16 13.14
PRESTRESSED TANK VERTICAL POST-TENSIONING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI): 506.2, Specification for Shotcrete.
2. American Society of Mechanical Engineers (ASME): B1.1, Unified Inch Screw Threads (UN and UNR Thread Form).
3. American Water Works Association (AWWA) D110, Wire and Strand-Wound, Circular, Prestressed Concrete Water Tanks.
4. ASTM International (ASTM):
    a. A90, Standard Test Method for Weight (Mass) of Coating on Iron or Steel Articles with Zinc or Zinc-Alloy Coatings.
    b. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    c. A416, Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
    d. A722, Standard Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete.
    e. B6, Standard Specification for Zinc.
    f. C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
    g. C94, Standard Specification for Ready-Mixed Concrete.
    h. C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
    i. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
    j. C233, Standard Test Method for Air-Entraining Admixtures for Concrete.
    k. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
    l. C457, Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete.
    m. C1018, Standard Test Method for Flexural Toughness and First-Crack Strength of Fiber-Reinforced Concrete (Using Beam With Third-Point Loading).
    n. C1116, Standard Specification for Fiber-Reinforced Concrete and Shotcrete.

5. International Concrete Repair Institute (ICRI): Technical Guideline No. 03732, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
6. Military Specification (MIL): MIL-P-21035, (Rev B) Paint, High Zinc Dust Content, Galvanizing Repair.
7. Precast/Prestressed Concrete Institute (PCI): MNL-120, (6th Ed) PCI Design Handbook—Precast and Prestressed Concrete.

1.02 DEFINITIONS

A. Shotcrete: Mortar projected by jet directly upon intended surface.

1.03 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00, Submittal Procedures.

B. Action Submittals:

1. Product Data:
   a. Epoxy grout.
   b. Grouting equipment proposed for use in grouting tendon ducting.
2. Design Data for Prestressing and Post-Tensioning:
   a. Fabrication details, erection drawings of prestressing and proposed post-tensioning systems, and source of materials.
   b. Design calculations showing initial and final prestressing force, stress losses due to plastic flow, shrinkage in concrete, creep in steel, anchorage losses, and machinery tolerances for circumferential prestressing.
   c. Load strain curves showing physical properties of steel.
   d. Number and location of vertical construction joints in wall.

C. Information Submittals:

1. Manufacturer’s Instructions:
   a. Proposed cold weather grouting procedures and techniques to keep wall grouting above freezing temperature until cured.
   b. Proposed wire splicing devices and anchorage for circumferential prestressing wire or strand.
   c. Method of spacing wire or strand for circumferential prestressing.
   d. Shotcrete:
      1) Mix design.
      2) Aggregate gradations.
      3) Fibrous shotcrete reinforcement.

4) Proposed admixtures.
5) Proposed mixing equipment and procedures.

e. Method of adding polypropylene fibers into shotcrete mix.

2. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements:
   a. For wire, strand, or bar used for prestressing and include:
      1) Chemical composition, physical properties, and dimensions of unit prior to galvanizing.
      2) Test data for a minimum of three samples of final galvanized unit taken from actual material to be used in Work.
   b. Certificate of each delivery of shotcrete showing manufacturer's name and product of the polypropylene fibers and amount of fiber added per cubic yard.
3. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.
4. Certificate of Successful Inspection: Prior to shipment, prestress units contain no apparent defects.
5. Written Test Reports:
   a. Threaded bars.
   b. Shotcrete strength.
6. Statement of Qualifications: Prestressing Subcontractor.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Prestressing Subcontractor: Minimum of 5 years of experience and experience with five tanks of similar size.
2. Shotcrete, Equipment, and Operator:
   a. Shotcrete shall be applied only by the Prestressing Subcontractor under a fully automated wet shotcrete mix process, using equipment mounted in the prestress machine.
   b. The operator shall be a full-time employee of the Prestressing Subcontractor with a minimum of 5 years' experience in using this automated equipment. Two years of this 5 years' experience shall be contiguous to this bidding period.

1.05 PRESTRESSING SUBCONTRACTOR SUPERINTENDENT ONSITE ASSISTANCE

A. Site Visits:

1. In addition to onsite work for prestressing operations, the General Contractor shall ensure that the superintendent for the Prestressing Subcontractor is present to provide onsite assistance to the Contractor during formwork and casting of the wall footing, selection and erection of wall formwork, bracing of wall formwork, installation of vertical prestress bars, and during placement of concrete into the wall forms.
2. Prestressing Subcontractor's superintendent shall provide guidance and expertise for placement of seismic cables, embeds for shotcreting, rubber pads, waterstops, vertical wall joints, wall to roof connections, and all other items in core wall and footing and inspect these items prior to casting concrete in core wall.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Bars:

1. Load bars manually or use nylon slings to avoid damage to galvanizing.
2. Support bars during handling and loading on trucks to avoid permanent bending and deformation.
3. Place bars on wooden supports and protect bars from rubbing by using tight metal band supports. Provide adequate burlap, plastic, or wood covering between metal bands and bars to avoid damage from bands and banding operations.
4. Place spacers between bars to reduce chipping of zinc during delivery.
5. Do not mix bars from one bundle to another. Keep bars in their respective bundles.
6. Identify packages or rolls of wire, strand, or bars with mill and heat number.

B. Prestressing Materials:

1. Prevent accumulation of moisture on materials or in wrapping.
2. Prevent rusting of circumferential wire or strand.
3. Handle and store vertical post-tensioning materials to prevent bending.

1.07 ENVIRONMENTAL REQUIREMENTS

A. When temperatures exceed 90 degrees F, obtain approval for method used to protect shotcrete from excessive heat and drying.

B. Delay Work under the following conditions:

1. During high winds causing sand to separate at the nozzle.
2. When weather approaches freezing defined as below 40 degrees F when temperature is falling, or until temperature is 35 degrees F when temperature is rising.
3. During rains of high intensity to wash cement out of fresh material.

C. Cold Weather: Take precautions to avoid low temperatures detrimental to epoxy grout or the ability to pump. If grouting procedure cannot be postponed, keep wall temperatures within the required temperature range.

PART 2 PRODUCTS

2.01 GENERAL

A. Reservoir shall be AWWA D110 Type I construction.

2.02 CIRCUMFERENTIAL PRESTRESSING STEEL

A. Solid Wire:

1. Hot-dipped galvanized continuous steel.
2. Diameter Tolerance Before Galvanizing: Plus or minus 0.002 inch.
3. Diameter Tolerance After Galvanizing: 0.001 inch.
4. Tensile Strength: 220,000 psi.
5. Yield Strength at 1-percent Extension: 180,000 psi.
6. Elongation in 10 inches at fracture 4 percent.
7. Bending (R equals 5D): 6 bends per 90 degrees.
8. Zinc Coating Weight: 0.85 ounce per square foot.

B. Seven-Wire Continuous Strand:

1. Meeting requirements of ASTM A416, Grade 270, prior to galvanizing.
2. Hot-dipped galvanized.
3. Nominal Strand Diameter: 3/8 inch.
4. Nominal Strand Area: 0.089 square inches (after galvanizing).
5. Nominal Weight per 1,000 Linear Feet: 303 pounds.
6. Pitch: 12-16 (strand diameter).
7. Minimum Breaking Strength after Galvanizing: 21,400 pounds.
8. Yield Strength at 1-percent Extension after Galvanizing: 16,000 pounds.
9. Elongation in 24 inches at Fracture: 4.5 percent.
10. Zinc Coating Weight: 0.85 ounce per square foot.

C. Anchorage for Wire or Strand: Prestressing manufacturer's standard, capable of safely developing 90 percent of full strength of wire or strand and not susceptible to galvanic action with wire or strand.

2.03 VERTICAL TENDONS

A. Threaded Bars:

1. Deformations of Threaded Bars:
   a. Form screw thread suitable for mechanically coupling lengths of threaded bar and for positive attachment of anchor assemblies.
   b. In accordance with ASTM A722, uniform such that all lengths of bar may be cut at any point and internal threads of a coupling designated for that size of bar freely screws on the bar.
2. Tensile and Physical Properties:
   a. Nominal Diameter: 1.25 inches or 1.375 inches.
   b. Minimum Tensile Stress: 150,000 psi.
   c. Minimum Yield Stress at 0.2 Percent Offset: 120,400 psi.
   d. Minimum elongation in 10-bar diameter 7 percent.
   e. Nominal Cross-section Area: 1.245 square inches for 1.25-inch diameter.
   f. Nominal Cross-section Area: 1.577 square inches for 1.375-inch diameter.
   g. Nominal Bar Weight: 4.39 pounds per foot for 1.25-inch diameter.
   h. Nominal Bar Weight: 5.56 pounds per foot for 1.375-inch diameter.
   i. Maximum Carbon Content: 0.55 percent.
3. Do not furnish thread bars with quenched or tempered steels.
4. Bars and their deformations shall be hot-rolled.

B. Smooth Bars:

1. Furnish with upset ends and rolled threads or cut threads.
2. Threads for Rods, Nuts, and Couplers: Equivalent to Unified Coarse Series as specified in ASME B1.1 with Class 2A tolerances.
3. Tensile and Physical Properties:
   a. Minimum Ultimate Tensile Strength: 145,000 psi.
   b. Minimum yield strength at 0.2 percent offset 125,000 psi.
   c. Approximate Modulus of Elasticity: 30,000,000 psi.
   d. Minimum elongation in 20 diameters after rupture 4 percent.
   e. Minimum reduction of area after rupture 20 percent.

C. Tendon Ducts:

1. 1-1/2-inch diameter, Class 200 PVC pipe, for 1.375-inch diameter bars.
2. Sufficient strength to maintain shape under potential forces created during handling, placing, and vibrating of concrete.

D. Anchorage:

1. Furnish anchor plates of steel to dimensions which will show no permanent physical distortion when tested with a unit of size required, together with standard anchorage devices, to 100 percent of the ultimate tensile strength of unit.
2. Size plate so concrete stresses shall meet allowable concrete bearing stresses in accordance with PCI MNL-120.
3. Anchor Nuts: Capable of holding 90 percent of ultimate strength of bars.
4. Conical hole in top and bottom bearing plates, 35-degree cone angle with vertical.
5. Fully threaded anchor connections at both bar ends, incorporating a nut with spherical-shaped bearing surface to match conical surface in the bearing plate.
6. Contact point of spherical-shaped bearing surface to conical hole approximately 1/4 inch to 1/2 inch below bearing plate surface.
7. Steel, grout-tight structural tube blockout, blockout size large enough to allow stressing and anchoring of bar.

2.04 EPOXY GROUT

A. Two-component water-insensitive epoxy.

B. Manufacturers:

1. Sika Chemical Co.
2. Adhesive Engineering Co.
3. Jeffco Products Co.

2.05 FIBROUS SHOTCRETE REINFORCEMENT

A. Manufacturers and Products:

1. Fibermesh Co., Chattanooga, TN; Stealth Fibers.
2. W.R. Grace & Co., Cambridge, MA; Grace MicroFiber.

B. Shotcrete, unless specified otherwise herein shall be fibrous reinforced. Reinforcement shall consist of 100 percent virgin polypropylene multi-filament fibers used as secondary reinforcement for shotcrete.

C. Required volume of fibers per cubic yard of shotcrete shall be 1.5 pounds.

D. Fibers shall be in accordance with ASTM C1116, Type III and ASTM C1018.

E. Physical Characteristics:

1. Specific Gravity: 0.91.
2. Tensile Strength: 40 ksi to 60 ksi.
3. Fiber Length: Graded per manufacturer.

F. Fibers shall be added to shotcrete in accordance with manufacturer's instructions.

2.06 SHOTCRETE

A. Fine Aggregates (Sand):

1. Saturated, surface-dry, hard, dense, uncoated rock fragments free from injurious amounts of foreign or deleterious substances as specified in Section 03 30 00, Cast-in-Place Concrete.
2. Fineness Modulus for Sand: Range from 2.70 to 3.00 with maximum particle size of 1/4 inch.
3. Maintain sand at 3 percent to 6 percent moisture content; dampen or dry with sand dryers if necessary.
4. Gradation:

Sieve Size	Percent Passing by Weight
No. 4	95 - 100
No. 8	80 - 90
No. 16	50 - 85
No. 30	25 - 60
No. 50	10 - 30
No. 100	2 - 10

B. Screen sand for finish coat, to produce dense surface uniform in texture and appearance.

C. Water and Cement: As specified in Section 03 30 00, Cast-in-Place Concrete.

D. Admixtures: As specified in Section 03 30 00, Cast-in-Place Concrete.

E. Shotcrete Strength (f'c):

1. Minimum 4,500 psi at 28 days based upon cylinders taken from wet mix prior to entering hose for shotcreting.
2. Minimum 5,000 psi at 28 days based upon samples taken from wet mix after being gunned onto a test panel or in final Work.
3. Higher shotcrete strengths shall not permit a reduction in cement contents.
4. Cement content for wet mix designs may be increased should the 28-day strength requirement not be met.

2.07 SHOTCRETE MIXING AND PROPORTIONING

A. General: In accordance with ACI 506.2. Where moderate wind is expected during shotcreting operation, make shotcrete mix richer to compensate for strength loss due to addition of moisture in mix and rapid loss during curing.

B. Wet Mix Process:

1. Each cubic yard of mortar shall consist of:
   a. Minimum 940 pounds Portland cement and 2,820 pounds moist sand.
   b. Admixtures: Up to 50 ounces may be added during warm weather conditions for applications other than overhead positions.
   c. Accelerating admixture shall contain no chlorides or corrosive chemicals for overhead applications.
2. Cold Temperature Conditions:
   a. Whenever night temperatures are expected to drop below 35 degrees F, use "high-early" Portland cement in lieu of regular Portland cement.
   b. If "high-early" Portland cement is not available, mix design shall consist of minimum 1,034 pounds regular Portland cement to 2,674 pounds moist sand without additives.
   c. Moist sand-cement mix ratio by weight, maximum 2.59 for site batching.
   d. Weight measuring equipment and tolerances in accordance with ASTM C94.
   e. Total volumetric air content 7 percent plus or minus 1 percent before placement as determined by ASTM C173 or ASTM C231. Air-entraining agents in accordance with ASTM C260, ASTM C233, and ASTM C457.
3. Mix shotcrete in either stationary plant, portable batch type, or truck mixers.

4. Admixture Products:
   a. Pro-Krete-R.
   b. Pozzolith 300 R.

PART 3 EXECUTION

3.01 GENERAL

A. Do not apply vertical post-tensioning and circumferential prestressing to reservoir until core wall has obtained the 28-day compressive field strength, as determined by test cylinders.

B. Stress all vertical post-tension units prior to circumferential prestressing and prior to roof concrete placement.

C. Installation includes, but not limited to:

1. Placement of vertical and circumferential prestressing units.
2. Placement of shotcrete.
3. Placement of anchorages by methods of prestressing.
4. Grouting vertical post-tensioning units.

D. Perform necessary welding in vicinity of post-tension bars with extreme caution to avoid touching post-tension bar with electrode and avoid electrical circuits that may cause resistance heating to pass through post-tension bars.

E. Do not use bent post-tension bars, bars with surface damage, and bars with rust.

F. Joints at base and top of wall are intended to act with minimum of restraint to wall as prestressing of wall is performed.

G. Expansion and vertical control joints have been designed to permit placing slabs and walls in sections and to minimize shrinkage cracks.

H. Do not provide horizontal construction joints in walls.

3.02 VERTICAL POST-TENSIONING

A. Do not weld vertical post-tensioning bars.

B. Bundles: Work only on one bundle of bars at one time. Do not open a new bundle until previous bundle has been banded and marked.

C. Marking:

1. Remove original plastic-coated paper or metal tag(s) from bundle.
2. Reinstate marking on rebundled bars before removing tags and before opening another bundle.

D. Placing Post-Tensioning Units:

1. Place post-tensioning units level and plumb in reservoir wall.
2. Encase vertical post-tensioning units in grout-tight tendon duct or pipe so mortar cannot enter and hinder free movement of bar.
3. Adequately vent tendon duct to facilitate grouting.
4. Thread end of vent tube at bottom of tendon duct and project from concrete; remove after grouting.
5. Tie units securely in position, supporting tendon ducts from top of form and keeping vent pipes perpendicular to wall.
6. Provide tight connections between anchorages, vent pipe, and forms to prevent movement or leakage of concrete into units during pouring operations.
7. Tension units from top ends.
8. After pouring first 8 feet of concrete wall and each subsequent lift of concrete, flush tendon ducts with water through top allowing water to drain from bottom vent pipe extending through wall form.
9. Provide threaded hose connections to threaded vent pipe and connections shall be tight to keep water from entering forms below.
10. Inform Engineer if units do not drain freely.
11. Allowable Stresses:
    a. Determine initial prestressing force for vertical bar units by using a 25,000 psi stress loss allowance for concrete shrinkage, plastic flow, and steel relaxation.
    b. Temporary jacking stresses up to 75 percent of ultimate strength for unit are acceptable to overcome losses due to tendon friction, anchorage seating, and elastic shortening.
    c. Initial stress in bar unit after anchorage losses have occurred shall not exceed 73.5 percent of ultimate strength of unit.
    d. Do not stress units before the 28-day concrete field strength has been obtained.

E. Anchorage Plate at Top of Unit: Provide grout-tight structural tube blockout, welded to top bearing plate and extending to top of wall, except extend tubes above wall where shown on Drawings.

F. Measurement of Tensioning and Elongation:

1. Field verify by measuring and recording both elongation and gauge reading on prestressing machine.
2. Calibrate gauge for this Project prior to starting Work and obtain comparable results between gauge readings and elongation readings.
3. Provide continuously, electronically, monitored permanent force/elongation record from zero to full force at final lockoff for vertical prestressing Work.
4. Show elongation in inches on ordinate axis of permanent recording and force in pounds or kips on abscissa axis.
5. Use manually recorded force and elongation readings to cross-check electronic recorder.

3.03 GROUTING OF VERTICAL TENDONS

A. Equipment: Provide grouting equipment with pressure gauge having a full-scale reading to 500 psi and capable of developing a minimum of 150-psi pressure.

B. Filling Tendon Ducts:

1. Ensure ducts are clean and free of water and deleterious materials that would impair bonding of grout or interfere with grouting procedures.
2. Fit grout injection pipes with positive mechanical shutoff valves.
3. Introduce epoxy grout through bottom grout pipe until it flows from and into steel blockout at top of unit.
4. Valve off bottom grout pipe.
5. Wait for a minimum of 12 hours following grouting operation before removing bottom tube.
6. Fill top steel blockout with upward moving grout 1/4 inch over top of anchor nut. Fill remaining space with two-component epoxy and pea gravel.

3.04 ANCHOR BOLTS

A. Install in top of roof slab sections near center of reservoir for anchoring and guying circumferential prestressing machine and equipment; where there is no roof slab, provide temporary structures to support prestressing equipment.

B. After prestressing operations are completed, remove anchors to minimum 1 inch below concrete surface and patch as specified.

3.05 CORE WALL PREPARATION

A. Concrete as specified in Section 03 30 00, Cast-in-Place Concrete.

B. Abrasive Blasting of Core Wall:

1. Inspect core wall and patched surfaces.
2. Patch surfaces requiring repair with shotcrete by building out in uniform circular area level with the existing core wall prior to abrasive blasting surface.
3. Test surfaces of all patches for chlorides or other chemicals that cause corrosion of prestressing.
4. Remove corrosive chemicals (if test prove positive for chlorides) from surfaces prior to abrasive blasting.
5. Abrasive blasting shall be performed by a mechanical etching or shotblast system combined with a vacuum recovery system, or a self-contained waterblasting system.
6. The surface shall be abrasive blasted sufficiently to remove all laitance, form oil, or other types of coatings.
7. The surface shall be cut to a minimum CSP 5 profile, as established by the ICRI Technical Guide No. 03732, over a minimum of 90 percent of the surface being prepared as measured over any one foot square area.
8. The Prestressing Subcontractor performing the abrasive blasting shall make available to the inspector ICRI sample coupons to assist in evaluating the abrasive cut.
9. Do not abrasive blast until walls are cured and have obtained the 28-day strength specified and tie holes have been dry packed and have cured for at least 7 days.
10. Complete abrasive blast prior to installation of the initial 3/8-inch shotcrete layer.

C. Shotcrete a uniform 3/8-inch layer over abrasively blasted surface prior to applying the initial circumferential prestressing, as indicated in Article Shotcreting of Circumferential Prestressing.

3.06 CIRCUMFERENTIAL PRESTRESSING

A. Apply uniformly stressed continuous steel wire or strand to concrete core wall using a wrapping machine to provide final prestressing force per linear foot of wall height. Use electronic servo controlled wrapping systems with automatic electronic recording.

B. Initial Prestress Force in Wire or Strand:

1. Maximum 75 percent of ultimate strength of strand or wire after anchoring.

2. Determine by using a stress loss of 25,000 psi for concrete shrinkage, plastic flow, and creep in steel plus the proven machine tolerance for electronic servo controlled wrapping machine with automatic electronic recording equipment.

C. Stress Measurement and Recording:

1. Continuously measure stress of wire or strand accurately as it is laid on the wall.
2. Electronic stress measuring and continuously recording apparatus shall be calibrated by a recognized gauge manufacturer or testing laboratory on wire or strand samples taken from prestressing wire or strand delivered to Site to be used in the Work.
3. Perform calibration work within 15 days prior to prestressing.
4. Do not use stress measuring device on other work until prestressing work is finished.
5. Recalibrate stress measuring apparatus during progress of the Work.
6. Provide automatic, electronic continuous recording at all points on wire around wall.
7. If stresses measured exceed values specified, discontinue operation and make satisfactory adjustments prior to proceeding with wrapping.
8. Apply additional wire or strand to compensate for understressed wire or strand.
9. Measure wire or strand stress by a continuous sensing of applied force on wire or strand between tensioning drum and wall when wire or strand is being wrapped and laid on wall. Measurement by deflecting wire or strand and/or die-drawing is not acceptable. Handheld stress measuring devices are not acceptable.
10. Force Tolerance: The applied force in the wire or strand shall not vary more than plus or minus 1.5 percent of the ultimate strength of the prestressing wire or strand and the prestressing equipment shall be capable of continuously adjusting the stress, as the wire or strand is being applied to the wall, to maintain this tolerance.

D. Splicing of Wire or Strand:

1. Do not weld splice strands.
2. Join ends of wires or strands with steel sleeves or splicing devices which will develop minimum 90 percent of full strength of strand without slippage or loss of stress.
3. Anchor stressed wire or strand only at designed wall sockets, or tie off at frequent intervals as stressing proceeds to minimize loss of stress in event of wire or strand break.
4. Remove from the Work coils of wire or strand which have broken three or more times.

5. Stress wire or strand only once.
6. Anchor wrapped strand to wall at least once for every coil or reel.
7. Do not permanently anchor one wire or strand to previously wrapped wire or strand.

E. Spacing:

1. Maximum Spacing:
   a. Five wires of 0.192 inch diameter, per foot of wall height.
   b. Two strands of 0.375 inch diameter, per foot of wall height.
2. Minimum Spacing:
   a. 22 wires of 0.192 inch diameter, per foot of wall height.
   b. 12 strands of 0.375 inch diameter, per foot of wall height.
3. Minimum clear spacing between units not less than 1.5 unit diameters or 3/8 inch, whichever is larger.

3.07 SHOTCRETING OF CIRCUMFERENTIAL PRESTRESSING

A. Shotcrete Layers:

1. After abrasive blasting, build up a minimum 3/8-inch cover over core wall prior to installing circumferential prestressing.
2. Build up intermediate shotcrete coatings in layers of approximately 3/8-inch thickness.
3. On reservoir walls and dome-rings start shotcrete at bottom of wall until wrapped wire is covered.
4. Subsequent shotcrete layers may be applied from top down or from bottom up.
5. While nozzle for automated equipment travels around wall, raise or lower nozzle at uniform rate for adequate overlapping of coatings and as uniform finish develops.

B. Multiple Layers of Circumferential Prestressing Units:

1. Apply shotcrete at minimum thickness.
2. A minimum of 3/8-inch cover for underlayer and intermediate layers, where more than one layer of circumferential prestressing units are required.
3. Minimum shotcrete cover over outer layer of prestressing wire or strand, 2 inches in thickness applied in several coats.

C. Application:

1. Apply coat of shotcrete to abrasively blasted core wall as well as between each layer of circumferential prestressing.
2. Operator shall spiral up or down and around the wall.

3. Ensure complete embedment of wires or strands without voids.
4. Ensure flow of material at nozzle is uniform at all times when nozzle is pointed toward the Work.
5. Cut out slugs, sand spots, or wet sloughs resulting from nonuniform material flow and repair as Work progresses.
6. Clear rebound away from Work before initial set occurs.

D. Slump and Moisture:

1. To achieve penetration around wire or strand and conveyance of material through hose, a 5-inch to 7-inch slump of mortar for wet mix process at pump is recommended.
2. Do not prewet wall prior to shotcrete application without written approval from Engineer, even in arid areas. Moisture absorption by earlier applied layers is relied upon to improve bond and strength of material and to reduce drying shrinkage of applied shotcrete.
3. Application of shotcrete in number and thickness of layers specified is mandatory to achieve penetration of shotcrete behind wire or strand and reduced shrinkage due to more uniform in-depth drying of shotcrete.

3.08 SHOTCRETE

A. General: In accordance with ACI 506.2. Apply shotcrete utilizing wet mix process.

B. Wet Mix Process Equipment:

1. Delivery Equipment:
   a. Ready-mix truck from a batching plant or mixer providing automatic weighing as specified in Section 03 30 00, Cast-in-Place Concrete.
   b. Capable of discharging mixed material into hose under close control, and able to deliver continuous smooth stream of uniformly mixed material at a velocity to automated discharge nozzle and free from slugs.
2. Automated Nozzle:
   a. Of design and size to ensure smooth and uninterrupted flow of materials.
   b. Mount on power driven machinery enabling nozzle to travel parallel to surface to be sprayed at uniform linear or bi-directional speed.
   c. Keep nozzle at uniform constant distance from surface, always ensuring a right-angle spray of material to surface.

d. Hand-operated nozzles and shotcreting operations dependent on performance of nozzleman are not acceptable except where additional shotcrete is needed to correct flat areas.

3. Thoroughly clean equipment at end of each shift.
4. Regularly inspect equipment parts and replace as necessary.
5. Air capacity of compressor large enough to supply minimum 400 cfm of air at nozzle, irrespective of whether or not air from same air supply is used for other purposes.

C. Shotcrete Field Tests:

1. Wet Mix Process: Where automated wet mix equipment is used, take shotcrete cylinders from mixer or ready-mix truck and test as specified in Section 03 30 00, Cast-in-Place Concrete.
2. When length of core is less than twice the diameter, apply correction factors in accordance with ASTM C42 to obtain compressive strength of individual cores.
3. Average compressive strength of three cores taken from test panel equal or exceed 0.85 f'c with no individual core less than 0.75 f'c. Average of three cubes taken from a panel shall equal or exceed f'c with no individual cube less than 0.88 f'c.
4. Shotcrete strength will be based on results obtained from cores or sawed cubes.
5. Use of data obtained from impact hammers, ultrasonic equipment, or nondestructive testing devices is not permitted. However, these devices may be used for determining uniformity of shotcrete.
6. Remove and replace shotcrete found not meeting tests, or cut cores and further test shotcrete, or repair and replace as approved by Engineer.

3.09 FINISHING OF SHOTCRETE

A. Underlayers or Exposed Surfaces:

1. On completing surface, bring shotcrete to an even plane and to well-formed corners by working up to ground wires or other thickness or alignment guides, using lower placing velocity than normal.
2. Screed exposed surfaces or underlayers by working upward against gravity with thin-edged screed using a slicing motion to trim off high spots and expose low spots.
3. Avoid pulling and breaking surface with subsequent checking.

B. Finish Layer:

1. Apply finish layer in several coats of 3/8-inch to 1/2-inch thickness to remove rough areas.

2. Carefully screen sand for finish coat to remove oversize particles which rebound and mar surfaces.
3. Surface of finish coat shall be of natural texture and coloration; free from spotting, cement or dust streaking, lap lines, uneven surfaces, and rebounded material.
4. Do not hand-patch.
5. Check coatings for bond by tapping lightly to test for hollow sounding spots.
6. Cut out areas where bond is not fully developed and repair.

C. Corrosion Protection:

1. Inspect core wall and patched surfaces.
2. Test surfaces for chlorides or other chemicals that cause corrosion of prestressing.
3. Remove corrosive chemicals from surfaces prior to sandblasting.
4. Patch surfaces by building out in uniform circular area level with surface.
5. Sandblast patches and core wall surfaces prior to application of prestressing and shotcrete.

3.10 WATER CURING OF SHOTCRETE

A. Initial and intermediate shotcrete layers shall be kept damp by hand watering or by use of a fine mist spray no sooner than 12 hours after the shotcrete has been applied.

B. Watercuring for initial and intermediate shotcrete layers is not required should additional shotcrete layers be applied to the entire wall surface within the following 12 hours.

C. Continuously water cure completed shotcrete surfaces for 7 days after application. The final 7-day water cure after the final shotcrete layer is applied shall be accomplished by one of two methods:

1. Keep the shotcrete continuously wet by water spraying.
2. Soak the shotcrete using the automated shotcrete machine and then encapsulate the shotcrete inside of plastic sheeting that is applied with the machinery. The plastic sheeting shall be tight, sufficiently lapped, and clear enough to inspect and see that water is present on the shotcrete continuously during the entire curing period. If water is not present and cannot be detected through the clear plastic, use machine or hand watering methods to soak the entire shotcrete surface.

D. Do not use curing compounds.

3.11 WATER LEAKAGE TEST

A. Perform water leakage test on reservoir as specified in Section 03 30 00, Cast-in-Place Concrete, except as indicated below:

1. Volume loss shall not exceed 0.05 percent of contained liquid volume in 24-hour period, correcting for evaporation, precipitation, and settlement.
2. Initial fill rate of reservoir shall not exceed 8 feet per 24 hours.

END OF SECTION

SECTION 33 47 13.01
RESERVOIR LINER—LLDPE GEOMEMBRANE

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service, and other Special Purpose Applications.
   b. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service, or both.
   c. A276, Standard Specification for Stainless and Steel Bars and Shapes.
   d. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
   e. D696, Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between Minus 30 degrees C and 30 Degrees C with Vitreous Silica Dilatormeter.
   f. D746, Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
   g. D792, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
   h. D1004, Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
   i. D1505, Standard Test Method for Density of Plastics by the Density-Gradient Technique.
   j. D2240, Standard Test Method for Rubber Property-Durometer Harness.
   k. D4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
   l. D5199, Standard Test Method for Measuring Nominal Thickness of Geosynthetics.
   m. D5397, Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.
   n. D5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
   o. D5994, Standard Test Method for Measuring Core Thickness of Textured Geomembrane.

p. D6392, Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
q. D6693, Standard Test Method for Determining the Tensile Properties of Nonreinforced Polyethylene and nonreinforced Flexible Polypropylene Geomembranes.

1.02 DEFINITIONS

A. Boot: Watertight collar fabricated from geomembrane sheet for sealing geomembrane to pipes and other objects that penetrate geomembrane.

B. Film Tearing Bond: Failure in ductile mode of one bonded sheet, by testing, prior to complete separation of bonded area.

C. Geomembrane: Essentially impermeable geosynthetic composed of one or more layers of polyolefin materials fusion bonded into single-ply integral sheet.

D. Panel: Piece of geomembrane composed of two or more sheets seamed together.

E. Sheet: Seamless piece of geomembrane.

F. Watertight: Geomembrane installation free of flaws and defects that will allow passage of water and gases, liquids, and solids to be contained under anticipated service conditions.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Manufacturer’s specifications, literature for each geomembrane furnished, and products used to complete installation.
   b. Compensation allowance calculation and numerical values for temperature induced geomembrane expansion and contraction.
   c. Polymer Resin: Product identification and Supplier.
   d. Geomembrane sheet layout with proposed size, number, position, and sequence of sheet placement, and location of field seams.
   e. Proposed equipment for material placement.
   f. Procedures for material installation.

B. Informational Submittals:

1. Qualifications:
   a. Manufacturer.
   b. Installer.
   c. Independent testing agency.
2. Quality Assurance Program: Written description of geomembrane manufacturers and installer's formal programs for manufacturing, fabricating, handling, installing, seaming, testing, and repairing geomembrane.
3. Production dates for geomembrane.
4. Testing:
   a. Factory QC test results for supplied geomembrane.
   b. Certified field seam test results.
5. Geomembrane Installer's Certification of Subsurface Acceptability: Form attached at end of this section.
6. Special guarantee.

1.04 QUALIFICATIONS

A. Independent Testing Agency: 5 years' experience in field of geomembrane testing. Laboratory shall maintain calibrated instruments, equipment, and documented standard procedures for performing specified testing.

B. Manufacturer: Successfully manufactured a minimum of 10 million square feet of each type of geomembrane material specified.

C. Installer: Successfully installed a minimum of 10 million square feet of each type of geomembrane product specified in applications similar to the Project.

D. Minimum qualifications stated above will be deemed met if the firm or cumulative experience of key personnel (supervisors and trained installation/testing technicians) proposed for this Project has minimum experience specified. If key personnel provision is used to qualify the firm, submit letter stating key personnel meet the minimum experience requirements and those individuals are available for and will be committed to this Project.

1.05 COORDINATION MEETINGS

A. Meet at least once prior to commencing each of the following activities:

1. Fabrication of panels and boots.
2. Installation of geomembrane.

B. Attendees:

1. Contractor's designated quality control representative.
2. Engineer.
3. Representatives of geomembrane installer.
4. Others requested by Engineer.

C. Topics:

1. Specifications and Drawings.
2. Submittal requirements and procedures.
3. Schedule for beginning and completing geomembrane installation.
4. Training for installation personnel.
5. Installation crew size.
6. Establishing geomembrane marking system, to include sheet identification, defects, and satisfactory repairs, to be used throughout Work.

D. Seam Installation and Testing Demonstration: Performed by geomembrane installer, for each type of seam required.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Geomembrane:

1. Individually package each sheet and protect from damage during shipment.
2. Mark each package with identification of material type, size, and weight.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not install geomembrane or perform seaming under the following conditions, unless it can be demonstrated to satisfaction of Engineer that performance requirements can be met under these conditions:

1. Air temperature is less than 35 degrees F or more than 90 degrees F.
2. Relative humidity is more than 90 percent.
3. Raining, snowing, frost is in ground, or wind is excessive.

B. Do not place granular materials on geomembrane when ambient temperature is less than 35 degrees F, unless it can be demonstrated to satisfaction of Engineer that materials can be placed without damage.

1.08 SEQUENCING AND SCHEDULING

A. Before placing geomembrane on soil surfaces, prepare subgrade as specified in Section 31 23 13, Subgrade Preparation.

B. Do not attach geomembrane to new concrete surfaces until after concrete has attained two-thirds of design compressive strength specified in Section 03 30 00, Cast-in-Place Concrete.

C. Do not place geomembrane over concrete surfaces until finish of concrete surfaces, as specified in Section 03 30 00, Cast-in-Place Concrete, is acceptable to Engineer.

1.09 SPECIAL GUARANTEE

A. Provide manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at option of Owner, removal and replacement of Work specified in this Specification section found defective during periods below, commencing on date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in General Conditions.

1. Guaranty geomembrane against manufacturing defects, deterioration due to ozone, ultraviolet, and other exposure to elements for period of 20 years on pro rata basis.
2. Guaranty geomembrane against defects in material and factory seams for period of 2 years.
3. Guaranty geomembrane against defects resulting from installation for period of 2 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Geomembrane:

1. Solmax, Houston, TX.
2. Poly-Flex, Inc., Grand Prairie, TX.
3. AGRU America, Georgetown, SC.

2.02 GEOMEMBRANE

A. Composition: Linear low-density polyethylene (LLDPE) containing no plasticizers, fillers, extenders, reclaimed polymers, or chemical additives, except following:

1. Approximately 2 percent by weight of carbon black to resin for ultraviolet resistance.
2. Antioxidants and heat stabilizers, not to exceed 1.5 percent total by weight, may be added as required for manufacturing.

B. Furnish in rolled single-ply continuous sheets with no factory seams.

C. Sheet Thickness: Minimum values determined in accordance with ASTM D5199 and shall not include ridges of rough-surfaced LLDPE geomembrane.

D. Sheet Width: Minimum 22 feet.

E. Roll Length: Longest that will be manageable and reduce field seams.

F. Rough-Surfaced LLDPE Geomembrane: Manufactured so that surface irregularities that produce specified friction are adequately fused into sheet or are extruded with sheet, on both sides of sheet. Texture is to be in addition to base thickness specified for sheet.

G. Meet manufacturer's most recent published specifications and required minimum LLDPE geomembrane values in this table.

Minimum Physical Properties for LLDPE Geomembrane		
Property	**Required Value**	**Test Method**
Specific Gravity	0.91 to 0.940, g/cc	ASTM D792, Method A-1 or ASTM D1505
Rough-Surfaced, LLDPE Minimum Properties, Each Direction		
Thickness, min., for thinner areas of textured sheet	54 mil	ASTM D5199, Modified Note 1, or ASTM D5994
Tensile Stress at Yield	1.5 lb/mil thickness	ASTM D6693, Type IV
Elongation at Break	250% minimum	ASTM D6693, Type IV
Puncture Resistance	1.2 lb/mil thickness	ASTM D4833

Minimum Physical Properties for LLDPE Geomembrane		
Property	**Required Value**	**Test Method**
Tear Resistance	0.55 lb/mil thickness	ASTM D1004, Die C
Brittleness Temperature	Minus 70º F, no cracks	ASTM D746 (Proc. B)
Hydrostatic Resistance	7.5 lb/sq in/mil thickness	ASTM D751, Method A
Bonded Seam Strength in Shear	1.5 lb/in-width/mil thickness, min. & FTB	ASTM D6392
Bonded Seam Strength in Peel	1.2 lb/in-width/mil thickness, min. & FTB	ASTM D6392

Notes:

1. Commercially available micrometers may be used that have a 60-degree taper to a point with a radius of 1/32 inch. Engineer shall make enough measurements of thinner areas of textured sheet to develop statistical basis for thickness.

H. Extrudate for Fusion Welding of LLDPE Geomembranes: Formulated from the same resin as geomembrane and shall meet applicable physical property requirements.

2.03 BOOTS

A. Fabricated of same material as geomembrane sheets to fit around penetrations, without folds, stretching, or unsupported areas.

B. Flanges:

1. Angle: Match slope or bottom where penetration passes through liner.
2. Width: Minimum 2 feet, plus dimension of penetration.

2.04 SEALANTS

A. Two-component sealant formulated of 100 percent polyurethane elastomer, such as Elastuff 120 Mastic as supplied by United Paint and Coatings, Greenacre, WA.

B. Butyl rubber sealant 2 inches wide by 1/8 inch thick.

2.05 STAINLESS STEEL BANDS

A. 300-series stainless steel having a minimum width of 15/16 inch.

B. As manufactured by Breeze Clamp Products, Saltsburg, PA.

2.06 STAINLESS STEEL BATTENS

A. In conformance with ASTM A276, Type 316 Grade A.

1. Flat Bars: 2 inches wide by 1/4 inch thick.

2.07 EPOXY ANCHOR SYSTEM

A. Anchor Rod: Conform to ASTM A193/A193M, Type 316 stainless steel threaded rod free of grease, oil, and other deleterious material.

B. Nuts: Stainless Steel, conform to ASTM A194/A194M, Type 316.

C. Washers: Flat, stainless steel, conforming to ASTM A194/A194M, Type 316.

D. Epoxy Adhesive:

1. Two-component, 100 percent solids, nonsag, paste, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
2. Conform to ASTM C881/C881M, Type 1, Grade 3, Class A, Class B, or Class C.
3. Cure Temperature, Pot Life, and Workability: Compatible for intended use and environmental conditions.
4. Manufacturers and Products:
    a. ITW Ramset/Red Head, Wood Dale, IL; Epcon Ceramic 6 Epoxy Anchor System.
    b. Hilti, Inc., Tulsa, OK; HIT Doweling Anchor System (HIT HY 150).
    c. Powers Rawl, New Rochelle, NY; Power Fast Epoxy Injection Gel Cartridge System.
    d. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Epoxy-Tie Adhesive ET22.
    e. Covert Operations, Inc., Long Beach, CA; CIA-Gel 7000 Epoxy Anchors.

2.08 NEOPRENE RUBBER PAD

A. Compression Strip Beneath Battens:

1. 3 inches wide by 1/4 inch thick.
2. 35 durometer to 45 durometer, in accordance with ASTM D2240 hardness.

B. Contact Cement: As recommended by neoprene rubber pad manufacturer.

C. Manufacturer: Aero Rubber Co., Inc., Bridgeview, IL.

2.09 CAST-IN-PLACE LLDPE EMBEDMENT

A. Properties: Formulated from the same resin as geomembrane and compatible for attaching geomembrane materials by extrusion welding to provide watertight seal.

B. Manufacturers:

1. Solmax, Houston, TX.
2. Poly-Flex, Inc., Grand View, TX.
3. AGRU America, Georgetown, SC.

2.10 FACTORY TESTING

A. Per standard factory testing program as approved by Engineer for the application.

PART 3 EXECUTION

3.01 PREPARATION

A. Geomembrane Inspection: During unwrapping visually inspect and mark each imperfection for repair.

B. Do not place geomembrane until condition of subgrade or geosynthetics installed is acceptable to Engineer.

C. Subgrade: Maintain in smooth, uniform, and compacted condition as specified in Section 31 23 13, Subgrade Preparation, during installation of geomembrane.

D. Concrete Surfaces in Contact with Geomembrane:

1. As specified in Section 03 30 00, Cast-in-Place Concrete, unless otherwise specified herein.
2. Provide smooth surface, free of projections, rough spots, voids, honeycomb, or other irregularities. Grind uneven concrete surface to which geomembrane is to be attached, flat and smooth. Round edges to minimum 1/2-inch radius.
3. Clean contact surfaces of dirt, dust, oil, curing compounds, and other coatings by sandblasting.

3.02 WELDING UNITS

A. Double hot-wedge fusion seam welding.

B. Extrusion welding systems.

C. Hot-air welding is not acceptable.

3.03 GEOMEMBRANE INSTALLATION

A. Prepare subgrade as specified in Section 31 23 13, Subgrade Preparation, and Section 31 23 23, Fill and Backfill.

B. Do not install geomembrane or seam unless Contractor can demonstrate successful performance and test results showing seams meet strength specifications.

C. Protection:

1. Do not use geomembrane surfaces as work area for preparing patches, storing tools and supplies, or other uses. Use protective cover as work surface, if necessary.
2. Instruct workers about requirements for protection of geomembrane, such as, handling geomembrane material in high winds, handling of equipment, and walking on geomembrane surfaces. Shoes of personnel walking on geomembrane shall be smooth bonded sole or be covered with smooth type of overboot. Prohibit smoking, eating, or drinking in vicinity of geomembrane, placing heated equipment directly on geomembrane, or other activities that may damage geomembrane.
3. Do not operate equipment without spark arrestors in vicinity of geomembrane material nor place generators or containers of flammable liquid on geomembranes.
4. Protect from vehicle traffic and other hazards.
5. Keep free of debris during placement.
6. Prevent uplift, displacement, and damage by wind.

7. Only small rubber-tired equipment, with maximum tire inflation pressure of 5 pounds per square inch, shall be allowed directly on geomembrane, unless otherwise approved by Engineer. Demonstrate that equipment can be operated without damaging geomembrane.

D. Placement:

1. Miscellaneous products required for completion of geomembrane installation shall be in accordance with this specification and geomembrane manufacturer's recommendations.
2. Reduce field seaming to the minimum amount possible. Horizontal seams on slopes will not be acceptable. Seams parallel to toe shall be at least 5 feet from toe. Align rough-sided sheets in manner that maximizes their frictional capabilities along slope.
3. Prevent wrinkles, folds, or other distress that can result in damage or prevent satisfactory alignment or seaming. Provide for factors such as expansion, contraction, overlap at seams, anchorage requirements, seaming progress, and drainage.
4. Temporarily weight sheets with sandbags to anchor or hold them in position during installation. Use continuous holddowns along edges to prevent wind flow under sheet.
    a. Bag Fabric: Sufficiently close knit to preclude fines from working through bags.
    b. Bags: Contain not less than 40 pounds nor more than 60 pounds of sand having 100 percent passing No. 8 screen and shall be securely closed after filling to prevent sand loss.
    c. Do not use tires or paper bags, whether or not lined with plastic. Burlap bags, if used, shall be lined with plastic.
    d. Immediately remove damaged or improperly sealed bags from work area, and clean up spills.
5. Anchor perimeter of geomembrane as shown or as otherwise approved by Engineer. Anchor and seal geomembrane to structures, pipes, and other types of penetrations as shown.
6. Place geomembrane immediately following completion of underlying geotextile installation and notification and approval of Engineer.
7. Place overlying geotextile immediately following completion of geomembrane installation, field testing, and notification and approval of Engineer.

E. Field Seams:

1. Wipe sheet contact surfaces clean to remove dirt, dust, moisture, and other foreign materials and prepare contact surfaces in accordance with seaming method accepted by Engineer.

2. Lap sheet edges to form seams. Adjust edges to be seamed and temporarily anchor to prevent wrinkling and shrinkage.
3. Seams shall not go through a boot. Locate seams minimum of 2 feet from boot.
4. Avoid seam intersections involving more than three thicknesses of geomembrane material. Offset seam intersections at least 2 feet. Extend seams through anchor trench to sheet edges.
5. Seal seam "T" intersections by removing excess material and extrusion welding lap joint.
6. Seam sheets together, using fusion-extrusion or hot-wedge welding system, equipment, and techniques.
    a. Double hot-wedge fusion welding shall be used for seaming all sheets and panels.
    b. Extrusion welds shall be used for repairing patches and details only.
7. Capping of Field Seams: Use 8-inch wide (minimum) cover strip of same thickness as geomembrane (and from same roll, if available). Position strip over center of field seam and weld to geomembrane using fillet weld each side, including copper wire as described above for spark testing.

F. Geomembrane Attachment to Flat Concrete Surfaces:

1. Concrete Anchors: Install in accordance with anchor manufacturer's written instructions and using manufacturer-supplied or manufacturer-recommended drills and equipment.
2. Position and fit geomembrane to be free of wrinkles at locations of attachment.
3. Tighten anchor bolt nuts to uniformly deform rubber pad beneath battens 12 percent to 15 percent of total thickness of rubber pad to obtain watertight connection of geomembrane to concrete surface.
4. LLDPE Embedments:
    a. Coordinate with Section 03 30 00, Cast-in-Place Concrete, and supplier.
    b. Attach to forms by nailing strip every 18 inches to ensure flat surface is tight against form.
    c. Allow 1/4-inch to 3/8-inch spacing between butt joints to allow for thermal expansion before welding joints.
    d. Allow 6-inch spacing from walls or edges of concrete.
    e. Chamfer ends of butt joints or intersection joints to allow for extrusion welding seal of strip.
    f. On sloped or horizontal surfaces, embedments with air release holes may be pushed into poured concrete.
    g. Seal nail and air holes with extrudate prior to installing membrane.

h. Make full perimeter weld of geomembrane to embedment to ensure maximum watertightness.

G. Boot Seals:

1. Preparation: Thoroughly clean contact surfaces.
2. Place boot around penetrations so flange is supported everywhere in full contact with subgrade and is free of wrinkles.
3. Seal boot to surrounding geomembrane as specified for field seams using extrusion-welding methods.
4. Tighten steel clamping bands until neoprene rubber pads are compressed 12 percent to 15 percent of total pad thickness.

3.04 INSTALLING GEOMEMBRANE IN TRENCHES

A. Place geomembrane in a way to avoid sharp corners and 90-degree bends. Round corners of trenches to approximately 45 degrees and a 2 inch radius.

B. Place geomembrane in a way and with sufficient slack for geomembrane to contact trench bottom and sides fully when trench is backfilled, with no folds or wrinkles.

3.05 PLACING PRODUCTS OVER GEOMEMBRANE

A. Prior to placing material over geomembrane, notify Engineer. Do not cover installed geomembrane until after Engineer provides authorization to proceed.

B. Haul trucks only allowed with minimum of 1-foot thick layer of granular drain material present over geomembrane.

C. Do not place soil and concrete materials in manner that will cause wrinkles to fold over or become confined to form a vertical ridge.

D. Place soil and concrete materials when geomembrane is cool and contracted and wrinkles are minimized.

E. If tears, punctures, or other geomembrane damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geomembrane, and repair damage as specified in Article Repairing Geomembrane.

F. Geomembrane installer shall remain available during placement of overlying products to repair geomembrane if damaged.

3.06 REPAIRING GEOMEMBRANE

A. Any geomembrane surface showing injury because of scuffing, penetration by foreign objects, or distress from rough subgrade shall be replaced or covered and sealed with an additional layer of geomembrane material of proper size.

B. Repair damage or rejected seams with pieces of flat and unwrinkled geomembrane material free from defects and seams. Patches shall be tightly bonded on completion of repair Work.

C. Patch shall be neat in appearance and of size 18 inches larger in all directions than area to be repaired. Round corners of patch to minimum 1-inch radius.

D. Prepare contact surfaces and seam patch in accordance with Paragraph Field Seams.

1. Pull and hold flat receiving surface in area to be patched.
2. Seal each patch by extrusion welding continuous bead along edge, with no free edge remaining. Vacuum box test each patch on completion.

3.07 FIELD QUALITY CONTROL

A. Prior to starting geomembrane installation and daily thereafter for installation on subgrade, geomembrane installer shall certify in duplicate that surface upon which geomembrane shall be installed is acceptable, on form located at end of section.

B. Identify each test by date of sample, date of test, sample location, name of individual who performed test, standard test method used, list of departures from standard test methods, at minimum.

C. In-Place Observation and Testing:

1. Visually inspect geomembrane sheets, seams, anchors, seals, and repairs for defects as installation progresses and again on completion.
2. Depending on seam welding equipment used, test each seam and repair using vacuum testing device, spark testing device, or air channel pressure test for double wedge welded seams.
3. Perform testing in presence of Engineer.

D. Field Testing Equipment:

1. Tensiometer:
   a. Motor driven portable tensile tester with jaws capable of traveling at measured rate of 2 inches per minute (for LLDPE).

b. Equip with gauge which measures force in unit pounds exerted between jaws.
c. Minimum capacity of 500 pounds.

2. Vacuum Box: Conform to ASTM D5641.
3. High Voltage Spark Detector: Tinker and Rasor Holiday Detector, Model AP-W, set at 20,000 volts.

E. Field Seam Sampling:

1. Verify that seaming equipment and operators are performing adequately. Produce test seam samples at beginning of each shift for each seaming crew. In addition, if seaming has been suspended for more than 1/2 hour, or if breakdown of seaming equipment occurs, produce test seam samples prior to resuming seaming.
2. Sample Size: 12 inches wide plus seam width, and 30 inches long.
3. Nondestructive Sampling:
   a. For boots and seams that cannot be otherwise tested, insert copper wire for spark test at edge of overlapping sheet in extrudate of weld prior to filet welding. Position to within 1/8 inch of sheet edge.
   b. Frequency: Minimum one Sample per 500 feet of field seam or portion thereof, and minimum one Sample per seaming crew per 4-hour work period.
   c. Produce Samples using same materials, equipment, personnel, and procedures as field seams made at time of work in progress and under same conditions.
4. Destructive Sampling:
   a. Frequency: Determined by Engineer.
   b. Remove Samples from field seams at locations selected by Engineer.
   c. Repair field seams in accordance with repair procedures specified in these Specifications.
5. Sample Identification:
   a. Number, date, and identify each sample as to personnel making seam and location of sample or location of field seam Work in progress at time Sample is made.
   b. Mark location of Sample, or location of field seam in progress at time sample is made, on panel/sheet layout drawing.
6. Contractor shall conform to the following testing requirements for nondestructive and destructive seam tests used to define quality of field seams:
   a. Perform shear and peel testing on portion of sample as specified hereinafter using approved field tensiometer.
   b. Send portion of sample by overnight service to approved Independent Testing Agency for verification of field test results.

c. Archive a portion of sample for potential verification testing later.
d. Independent Testing Agency shall provide preliminary test results by emailed portable document format (pdf) or other means no later than 24 hours after Samples have been received from Contractor, unless otherwise approved by Engineer. Certified test results shall be provided no more than 7 days after Samples have been received from Contractor.

7. Conform to ASTM D6392 and this specification.
   a. Seam testing for geomembrane includes strength tests, vacuum box testing, high voltage spark tests, air channel pressure tests, and probing.
   b. Leak testing includes water level leakage testing and electrical resistivity testing and tracer dye leakage testing.

F. Field Seam Strength Sample Testing:

1. General:
   a. Test each sample for seam peel and tensile strength.
   b. Save test samples, including specimens tested, until notified by Engineer relative to their disposal.
   c. Each sample that fails under test shall be shipped immediately by express delivery to Engineer for determination of corrective measures required.
2. Field Seam Acceptance Criteria: Seam strength equal to 90 percent of that of parent material. Parent material shall be tested in accordance with ASTM D6392.
   a. Bonded Shear Strength of LLDPE:
      1) In Shear: Minimum 2 pounds per inch width per mil thickness as determined in accordance with ASTM D6392.
      2) In Peel: Minimum 1.2 pounds per inch width per mil thickness as determined in accordance with ASTM D6392.
3. Test Failure: If sample fails, entire field seam from which it was taken shall be considered a failure and shall be rejected as a result of nonconformance with specification requirements. Comply with following corrective measures:
   a. Nondestructive Sample Failure: Rerun field weld test using same sample. If that test passes, Engineer may assume error was made in first test and accept field seam. If second test fails, cap each field seam represented by failed sample and submit new test Sample made during capping procedure.

b. Destructive Sample Failure: Rerun field weld test using new sample from same seam. If that test passes, Engineer may assume error was made in first test and accept field seam. If second test fails, either cap field seam between two previous passed seam test locations that include failed seam or take another sample on each side of failed seam location (10 feet minimum), and test both. If both pass, cap field seam between two locations. If either fails, repeat process of taking samples for test. Each field seam shall be bounded by two passed test locations prior to acceptance.

G. Vacuum Box Testing of Geomembrane Welds:

1. Vacuum box test each of these types of welds: Fillet, extrusion lap, and single hot-wedge fusion lap.
2. Testing Procedures: Conforming to ASTM D5641.

H. High-Voltage Spark Testing of Fillet Welds:

1. Provide each seam to be tested with copper wires properly embedded in seam with provisions for electrical grounding to test equipment.
2. Pass spark tester along length of seam containing copper wire.
3. Presence of a visible spark along tested seam shall be evidence of a faulty seam.
4. Mark faulty areas for repair and retesting.

I. Air Channel Pressure Testing of Double Hot-Wedge Seam:

1. Insert a needle with gauge in air space between welds. Pump air into space to 30 psi and hold for 5 minutes.
2. At end of 5 minutes, depressurize seam by placing needle hole in air space between welds at opposite end of seam and observe gauge.
3. Seam is acceptable if seam maintains at least 27 psi during 5-minute hold and pressure drops within 30 second of depressurization.
4. Seam is acceptable if seam maintains a minimum of 27 psi. If pressure drops below 27 psi during test period, or does not drop during 30-second depressurization period, repair needle holes and retest seam by same procedure or vacuum box test along entire length of seam.
5. Vacuum box test entire length of seam if second air pressure test fails.
   a. If no bubbles appear in vacuum box, lower weld will be considered defective and upper seam is acceptable.
   b. If bubbles appear in vacuum box, repair each defective area by extrusion welding and test again by vacuum box.

6. As alternative to vacuum box testing, apply soap solution to exposed seam edge while maintaining required air channel test pressure.
    a. If bubbles appear, mark, trim unbonded edge, and extrusion weld defective areas.
    b. If no bubbles appear and test pressure cannot be maintained, leak is judged to be in bottom or second seam.
7. If leak is judged to be in bottom seam, cap strip length of seam tested will be accepted.
8. Mark and repair needle holes.

J. Documentation:

1. Record Documents, include the following:
    a. Panel and sheet numbers.
    b. Seaming equipment and operator identification.
    c. Temperature and speed setting of equipment.
    d. Date seamed.
    e. Identity and location of each repair, cap strip, penetration, boot, and sample taken from installed geomembrane for testing.

3.08 MANUFACTURER'S SERVICES

A. Provide authorized representative of geomembrane manufacturer onsite for technical supervision and assistance during the following:

1. Preparation and inspection of surfaces on which geomembrane is to be placed.
2. Inspection of geomembrane prior to installation.
3. Installation of geomembrane.
4. Placement of cover over installed geomembrane.
5. Certification of Proper Installation.

3.09 CLEANUP

A. Clean up work area as the Work proceeds. Take particular care to ensure that no trash, tools, and other unwanted materials are trapped beneath geomembrane and that scraps of geomembrane material are removed from the work area prior to completion of installation.

3.10 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this Specification.

1. Geomembrane Installer's Certification of Subsurface Acceptability.

END OF SECTION

GEOMEMBRANE INSTALLER'S CERTIFICATION
OF
SUBSURFACE ACCEPTABILITY

Geomembrane installer, _____
for Project, hereby certify that supporting surfaces are acceptable for installation of geomembrane, undersigned having personally inspected condition of existing and prepared surfaces. This certification is for areas shown on Attachment or defined as follows:

_____

_____

_____

_____

Condition of supporting surfaces in defined area meets or exceeds minimum requirements for installation of geomembrane.

Signed: _____
(Representative of Geomembrane Installer)

_____
(Position)

Date: _____

Witness: _____

SECTION 40 05 15
PIPING SUPPORT SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads for Buildings and Other Structures.
2. American Society of Mechanical Engineers (ASME): B31.1, Power Piping.
3. ASTM International (ASTM):
   a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   b. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
   c. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
4. International Code Council (ICC):
   a. International Building Code (IBC).
   b. International Mechanical Code (IMC).
5. Manufacturers Standardization Society (MSS):
   a. SP 58, Pipe Hangers and Supports - Materials, Design and Manufacture.
   b. SP 69, Pipe Hangers and Supports - Selection and Application.
   c. SP 89, Pipe Hangers and Supports - Fabrication and Installation Practices.
   d. SP 127, Bracing for piping Systems, Seismic-Wind-Dynamic Design, Selection and Application.

1.02 DEFINITIONS

A. Wetted or Submerged: Submerged, less than 1 foot above liquid surface, below top of channel wall, under cover or slab of channel or tank, or in other damp locations.

1.03 SUBMITTALS

A. Action Submittals:

1. Catalog information and drawings of piping support system, locating each support, sway brace, seismic brace, hanger, guide, component, and anchor for piping 6 inches and larger. Identify support, hanger, guide, and anchor type by catalog number and Shop Drawing detail number.
2. For piping 4 inches and smaller provide catalog information for each type of support.
3. Revisions to support systems resulting from changes in related piping system layout or addition of flexible joints.
4. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Component and attachment testing certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
2. Maintenance information on piping support system.

1.04 QUALIFICATIONS

A. Piping support systems shall be designed and Shop Drawings prepared and sealed by a Registered Professional Engineer in the state where the Work is to be installed.

1.05 DESIGN REQUIREMENTS

A. General:

1. Design, size, and locate piping support systems throughout facility, whether shown or not.
2. Piping Smaller than 30 Inches: Supports are shown only where specific types and locations are required; additional pipe supports may be required.
3. Piping 30 Inches and Larger: Support systems have been designed for piping shown.
4. Meet requirements of MSS SP 58, MSS SP 69, MSS SP 89, and ASME B31.1 or as modified by this section.

B. Pipe Support Systems:

1. Pipe support systems shall be designed for gravity and thrust loads imposed by weight of pipes or internal pressures, including weight of fluid in pipes and insulation.
2. Seismic loads in accordance with governing codes and as shown on Structural General Drawings.
3. Wind loads in accordance with governing codes and as shown on Structural General Drawings.
4. Maximum support spacing and minimum rod size in accordance MSS SP-69 Table 3 and Table 4.

C. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.

D. Vertical Sway Bracing: 10-foot maximum centers or as shown.

PART 2 PRODUCTS

2.01 GENERAL

A. When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated.

B. Special support and hanger details may be required for cases where standard catalog supports are inapplicable.

2.02 HANGERS

A. Clevis: MSS SP-58 and SP-69, Type 1.

1. Anvil; Figure 260, sizes 1/2 inch through 30 inches.
2. For Insulated Pipe: Anvil; Figure 260 with insulated saddle system (ISS) sizes 1/2 inch through 16 inches.
3. B-Line; Figure B3100, sizes 1/2 inch through 30 inches.

2.03 SADDLE SUPPORTS

A. Pedestal Type: Stanchion, saddle, and anchoring flange shall be made out of Type 304 stainless steel.

1. Nonadjustable Saddle: MSS SP 58 and MSS SP 69, Type 37 with U-bolt.
   a. Anvil; Figure 259, sizes 4 inches through 36 inches with Figure 62C base.

b. B-Line; Figure B3090, sizes 3/4 inches through 36 inches with B3088 base.

2. Adjustable Saddle: MSS SP 58 and MSS SP 69, Type 38 without clamp.
   a. Anvil; Figure 264, sizes 2-1/2 inches through 36 inches with Figure 62C base.
   b. B-Line; Figure B3093, sizes 1 inch through 36 inches with Figure B3088T base.

B. Elbow and Flange Supports shall be made out of Type 304 stainless steel:

1. Elbow with Adjustable Stanchion:
   a. Sizes 2-1/2 inches through 42 inches.
      1) Anvil; Figure 62C base.
2. Elbow with Nonadjustable Stanchion:
   a. Sizes 2-1/2 inches through 42 inches.
      1) Anvil; Figure 63C base.
3. Flange Support with Adjustable Base:
   a. Sizes 2 inches through 24 inches.
      1) B-Line; B3094, with Figure B3088T base.
      2) Standon; Model S89.

2.04 WALL BRACKETS AND SUPPORTS

A. Welded Steel Wall Bracket: MSS SP 58 and MSS SP 69, Type 33 (heavy-duty).

1. Anvil; Figure 199, 3,000-pound rating.
2. B-Line; Figure B3067, 3,000-pound rating.

B. Adjustable “J” hanger MSS SP 58 and MSS SP 69, Type 5:

1. Anvil; Figure 67, sizes 1/2 inch through 8 inches.
2. B-Line; Figure B3690, sizes 1/2 inch through 8 inches.

C. Offset Pipe Clamp:

1. Anvil; Figure 103, sizes 3/4 inch through 8 inches.
2. B-Line; Figure B3148, sizes 1/2 inch through 12 inches.

D. Channel Type:

1. Unistrut.
2. Anvil; Power-Strut.
3. B-Line; Strut System.
4. Aickinstrut (FRP).

2.05 PIPE CLAMPS

A. Riser Clamp: MSS SP 58 and MSS SP 69, Type 8.

1. Anvil; Figure 261, sizes 3/4 inch through 24 inches.
2. B-Line; Figure B3373, sizes 1/2 inch through 30 inches.

2.06 CHANNEL TYPE SUPPORT SYSTEMS

A. Channel Size: 12-gauge, 1-5/8-inch wide minimum steel, or 1-1/2-inch wide, minimum FRP.

B. Members and Connections: Design for loads using one half of manufacturer's allowable loads.

C. Fasteners: Vinyl ester fiber, polyurethane base composite nuts and bolts, or encapsulated steel fasteners.

D. Manufacturers and Products:

1. B-Line; Strut System.
2. Unistrut.
3. Anvil; Power-Strut.
4. Aickinstrut (FRP System).
5. Enduro-Durostrut (FRP Systems).

2.07 ACCESSORIES

A. Type: U-bolts with double nuts to provide nominal 1/8-inch to 1/4-inch clearance around pipe. MSS SP 58 and MSS SP 69, Type 24.

1. Anvil; Figure 137 and Figure 137S.
2. B-Line; Figure B3188 and Figure B3188NS.

B. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.

C. Attachments:

1. Concrete Insert: MSS SP 58 and MSS SP 69, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.
2. U-Channel Concrete Inserts: As specified in Section 05 50 00, Metal Fabrications.
3. Concrete Attachment Plates:
   a. Anvil; Figure 47, Figure 49 or Figure 52.
   b. B-Line; Figure B3084, Figure B3085 or Figure B3086.

2.08 PIPE ANCHORS

A. Type: Anchor chair with U-bolt strap.

B. Manufacturer and Product: B-Line; Figure B3147A or Figure B3147B.

2.09 ANCHORING SYSTEMS

A. Size and Material: Sized by equipment manufacturer, and as specified in Section 05 50 00, Metal Fabrications.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Install support systems in accordance with MSS SP 69 and MSS SP 89, unless shown otherwise.
2. Install pipe hanger rods plumb, within 4 degrees of vertical during shut down, start up or operations.
3. Support piping connections to equipment by pipe support and not by equipment.
4. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
5. Support no pipe from pipe above it.
6. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
7. Do not install pipe supports and hangers in equipment access areas or bridge crane runs.
8. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.
9. Install lateral supports for seismic loads at changes in direction.
10. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
11. Repair mounting surfaces to original condition after attachments are made.

B. Standard Pipe Supports:

1. Horizontal Suspended Piping:
   a. Single Pipes: Adjustable swivel-ring, split-ring, or clevis hangers.
   b. Grouped Pipes: Trapeze hanger system.

2. Horizontal Piping Supported from Walls:
   a. Single Pipes: Wall brackets or wall clips attached to wall with anchors. Clips attached to wall mounted framing also acceptable.
   b. Stacked Piping: Wall mounted framing system and clips acceptable for piping smaller than 3-inch minimal diameter.
   c. Piping clamps that resist axial movement of pipe through support are not acceptable. Use cast iron hanging rolls supported from wall bracket.
3. Horizontal Piping Supported from Floors:
   a. Stanchion Type:
      1) Pedestal type; adjustable with stanchion, saddle, and anchoring flange.
      2) Use yoked saddles for piping whose centerline elevation is 18 inches or greater above floor and for exterior installations.
      3) Provide minimum 1-1/2-inch grout beneath base plate.
   b. Floor Mounted Channel Supports:
      1) Use for piping smaller than 3-inch nominal diameter running along floors and in trenches at piping elevations lower than can be accommodated using pedestal pipe supports.
      2) Attach channel framing to floors with base plate on minimum 1-1/2-inch grout and with anchor bolts.
      3) Attach pipe to channel with clips or pipe clamps.
   c. Concrete Cradles: Use for piping larger than 3 inches along floor and in trenches at piping elevations lower than can be accommodated using stanchion type.
4. Vertical Pipe: Support with wall brackets and base elbow or riser clamps on floor penetrations.
5. Standard Attachments:
   a. To Concrete Ceilings: U-Channel Concrete Inserts, U-Channel to Concrete Attachment Plates.
   b. To Concrete Walls: Concrete inserts or brackets or clip angles with anchor bolts.
   c. To Concrete Beams: U-Channel Concrete Inserts, or if inserts are not used attach to vertical surface similar to Concrete Wall. Do not drill into beam bottom.
   d. Existing Walls and Ceilings: Install as specified for new construction, unless shown otherwise.

C. Accessories:

1. Dielectric Barrier:
   a. Provide plastic coated hangers, or isolation tape such as B-Line Iso Pipe, B-Line B1999 Vibra Cushion, or B-Line B3195 Felt Isolators between painted or galvanized carbon steel members and copper or stainless steel pipe or between stainless steel supports and nonstainless steel ferrous metal piping.
   b. Install 1/4-inch by 3-inch neoprene rubber wrap between submerged metal pipe and oversized clamps.

3.02 FIELD FINISHING

A. Paint atmospheric exposed surfaces hot-dip galvanized steel components as specified in Section 09 90 00, Painting and Coating.

END OF SECTION

SECTION 40 27 02
VALVES AND OPERATORS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this Section:

1. American Society of Mechanical Engineers (ASME):
   a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250).
   b. B16.44, Manually Operated Metallic Gas Valves for Use in Aboveground Piping Systems up to 5 PSI.
2. American Water Works Association (AWWA):
   a. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   b. C500, Metal-Seated Gate Valves for Water Supply Service.
   c. C504, Rubber-Seated Butterfly Valves.
   d. C507, Ball Valves, 6 in. Through 48 in. (150 mm Through 1200 mm).
   e. C508, Swing-Check Valves for Waterworks Service, 2-in. through 24-in. (50 mm Through 600 mm) NPS.
   f. C509, Resilient-Seated Gate Valves for Water Supply Service.
   g. C510, Double Check Valve, Backflow Prevention Assembly.
   h. C512, Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
   i. C511, Reduced-Pressure Principle Backflow Prevention Assembly.
   j. C515, Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
   k. C550, Protective Interior Coatings for Valves and Hydrants.
   l. C606, Grooved and Shouldered Joints.
   m. C800, Underground Service Line Valves and Fittings.
3. ASTM International (ASTM):
   a. A276, Standard Specification for Stainless Steel Bars and Shapes.
   b. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
   c. A564/A564M, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
   d. B61, Standard Specification for Steam or Valve Bronze Castings.
   e. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

f. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
g. B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
h. B139, Standard Specification for Phosphor Bronze Rod, Bar and Shapes.
i. B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
j. B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
k. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
l. D429, Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.
m. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

4. Food and Drug Administration (FDA).
5. Manufacturers Standardization Society (MSS):
   a. SP-80, Bronze Gate, Globe, Angle and Check Valves.
   b. SP-81, Stainless Steel, Bonnetless, Flanged Knife Gate Valves.
   c. SP-85, Gray Iron Globe & Angle Valves, Flanged and Threaded Ends.
   d. SP-88, Diaphragm Valves.
   e. SP-110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
6. NSF International (NSF): 61, Drinking Water System Components-Health Effects.
7. UL.
8. USC Foundation for Cross-Connection Control and Hydraulic Research.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Product data sheets for each make and model. Indicate valve Type Number, applicable Tag Number, and facility name/number or service where used.
   b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
   c. Power and control wiring diagrams, including terminals and numbers.
   d. Complete motor nameplate data.

e. Complete electric motor actuators submittal data.
f. Sizing calculations for open-close/throttle and modulating valves.

B. Informational Submittals:

1. Manufacturer's Certificate of Compliance, in accordance with Section 01 43 33, Manufacturers' Field Services, for butterfly valves, full compliance with AWWA C504.
2. Certification for compliance to NSF 61 for valves used for drinking water service. Owner may allow and internationally accepted equivalent of NSF 61.
3. Tests and inspection data.
4. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
5. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

PART 2 PRODUCTS

2.01 GENERAL

A. Valves to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, operating nut, worm and gear operator, chain, wrench, and accessories to allow a complete operation from the intended operating level.

B. Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.

C. Valve same size as adjoining pipe, unless otherwise called out on Drawings.

D. Valve ends to suit adjacent piping.

E. Resilient seated valves shall have no leakage (drip-tight) in either direction at valve rated design pressure. All other valves shall have no leakage (drip-tight) in either direction at valve rated design pressure, unless otherwise allowed for in this section or in stated valve standard.

F. Size operators and actuators to operate valve for the full range of pressures and velocities.

G. Valve to open by turning counterclockwise.

H. Factory mount operator, actuator, and accessories.

I. Owner may accept valves as "equal" if, in Owner's judgement, they meet project-specific needs even if they don't meet all specified requirements.

J. Flanges and bolting shall mate properly at valves and piping flanges and meet all pressure requirements. Submit coordinated flanges, bolting and gaskets.

K. Flanges on valves shall be faced and prepared to seal with the specified gaskets. If special gaskets are required, notify the Engineer immediately and identify requirements on the submittals. Provide the required gaskets, either the standard gaskets as specified, or specialty gaskets that may be required by the valve manufacturer.

L. Valves shall mate to standard AWWA or ASME flanges as specified. Coordinate mating surface between valves and piping. Any exposed flange surfaces, not covered by a sealing gasket, shall be coated to prevent corrosion.

2.02 MATERIALS

A. Bronze and brass valve components and accessories that have surfaces in contact with water to be alloys containing less than 16 percent zinc and 2 percent aluminum.

1. Approved alloys are of the following ASTM designations: B61, B62, B98/B98M (Alloy UNS No. C65100, C65500, or C66100), B139 (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.
2. Stainless steel Alloy 18-8 may be substituted for bronze.

B. Valve materials in contact with or intended for drinking water service to meet the following requirements:

1. Comply with requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements.
2. Coatings materials to be formulated from materials deemed acceptable to NSF 61.
3. Furnish certification that product is certified as suitable for contact with drinking water by an accredited certification organization in accordance with NSF 61. Provide certification for each valve type used for drinking water service.

2.03 FACTORY FINISHING

A. Epoxy Lining and Coating:

1. In accordance with AWWA C550 unless otherwise specified.
2. Either two-part liquid material or heat-activated (fusion) material except only heat-activated material if specified as “fusion” or “fusion bonded” epoxy.

3. Minimum 7-mil dry film thickness except where limited by valve operating tolerances.

B. Exposed Valves:

1. In accordance with Section 09 90 00, Painting and Coating.
2. Safety isolation valves and lockout valves with handles, handwheels, or chain wheels “safety yellow.”

2.04 VALVES

A. Gate Valves:

1. General:
   a. AWWA gate valves to be in full compliance with stated AWWA standard and the following requirements:
      1) Provide 2-inch operating nut and handwheel for AWWA gate valves 12 inches and smaller.
      2) Provide totally enclosed spur or bevel gear operator with indicator for AWWA gate valves 14 inches and larger.
      3) Provide Affidavit of Compliance per the applicable AWWA standard for AWWA gate valves.
      4) Mark AWWA gate valves with manufacturer’s name or mark, year of valve casting, valve size, and working water pressure.
      5) Repaired AWWA gate valves shall not be submitted or supplied.
      6) AWWA C509 and AWWA C515 valves may be substituted for each other.
2. Type V130 Resilient Seated Gate Valve 3 Inches to 20 Inches:
   a. Ductile iron body, resilient seat, bronze stem and stem nut, ANSI Class 125 flanged ends, nonrising stem (with 2-inch operating nut), in accordance with AWWA C509, minimum design working water pressure 175 psig, full port, fusion-epoxy coated inside and outside per AWWA C550, NSF 61 certified. Each valve shall be drip tight in both directions. For all buried valves, provide valve box and extension rod to the surface per drawing details. For all non-buried valves, provide handwheel. Provide manual position indicator switch.
   b. Manufacturers and Products:
      1) Mueller; 2300 Series Resilient Wedge Gate Valve.
      2) Clow; 2600 Series Resilient Wedge Gate Valve.
      3) “Or-equal.”

B. Ball Valves:

1. Type V307 SST Ball Valve 3 Inches and Smaller: Two or three-piece, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body and end pieces, full port Type 316 stainless steel ball, threaded ends, reinforced PTFE seats, body seal and stem packing, blowout-proof stainless-steel stem, stainless-steel lever operator with vinyl grip, rated 1,000-pound WOG, 150 psi SWP. Valves shall be rated drip tight to 250 psi cold water pressure.
   a. Manufacturers and Products:
      1) Milwaukee; 30 Series.
      2) Nibco; T-595-S6-R-66-LL.
      3) Conbraco Apollo; 86-500 Series.

C. Butterfly Valves:

1. General:
   a. In full compliance with AWWA C504 and following requirements:
      1) Suitable for throttling and isolation operations and infrequent operation after periods of inactivity.
      2) The butterfly valve shall be of the double offset or triple offset design whereby the elastomeric seat is not in compression at any degree of opening except at full closure.
      3) All valves unless noted otherwise, shall be sized for bi-directional water service, full rated pressure and a line velocity of 16 feet per second.
      4) Valves shall be zero leakage with rated 250 psi pressure applied in shop tests across closed valve in each direction. Valves shall be zero leakage across closed valve during field test to rated system pressure in each direction.
      5) No travel stops for disc on interior of body.
      6) Isolate metal-to-metal thrust bearing surfaces from flowstream.
      7) Provide traveling nut or worm gear actuator with handwheel. Valve actuators to meet the requirements of AWWA C504.
      8) Buried service operators shall withstand 450 foot-pounds of input torque at fully open and fully closed positions.
      9) Unless otherwise indicated, all manually actuated butterfly valves shall be equipped with a hand wheel and 2-inch square actuating nut and position indicator.

10) Provide linings and coatings per AWWA, unless otherwise indicated on Drawings or specified herein.
11) Valves to be in full compliance with NSF 61. Provide NSF 61 certificate for each valve.

2. Type V504 Butterfly Valve Water Works Service 3 Inches to 48 Inches:
   a. AWWA C504, Class 250B. ANSI B16.1 class 125-pound flanges compatible with AWWA Class D flanges.
   b. This valve will be electrically actuated. See Section 40 27 03, Electric Motor Actuators.
   c. Provide 30-inch valves with 12-inch lay length, 16-inch and 12-inch valves with 8-inch lay length.
   d. Elastomeric Seal: Provide EPDM valve seat as one continuous 360-degree ring mounted on valve disc with Type 316 stainless steel fasteners that do not penetrate EPDM. Seat shall be field replaceable and adjustable in line without requiring special tools or skills or more than 8 hours. Seats with hardened epoxy or grout in a dovetailed groove are not allowed.
   e. Body: Ductile iron per ASTM A536 65-45-12 or ASTM A536 60-40-18. Shear-stress-vulnerable cast iron is not allowed. Valve body shall have stainless steel stamped or engraved tag indicating manufacturer and build data. Valve build data shall be made available upon request by the Owner and shall be retained by the manufacturer for no less than 2 times the expected valve life.
   f. Disc: Ductile iron for valves sizes 3 inches to 20 inches. Ductile iron, ASTM A536 65-45-12 or ASTM A536 60-40-18 for valves 24 inches and larger. Disc elastomeric seal retainer shall be Type 316 stainless steel. Fasten disc to the valve shaft with tangential stainless steel shaft pins, Type 316 or higher alloy. Mechanically retain disc pins which extend completely through valve.
   g. Shaft: Valve shafts shall be ASTM A276 Type 316 stainless steel. Shaft material shall be suitable for application pressure and velocity.
   h. Metallic Seat: Stainless steel alloy valve seat shall be located in valve body. There shall be no gap between the valve body and metallic body seat and consequently no potential for corrosion or lifting of seat. Attach seat by high alloy weld overlay process.

i. Shaft Seals: Provide multi O-ring seals protecting both inside and outside and inside of shaft. Seals shall not need periodic manual adjustment. Seals shall prevent pressurized water from entering uncoated valve disc hub and valve body shaft bore. Seals shall keep valve shaft un-wetted and unpressurized so actuator may be removed without dewatering the pipeline. Seals shall prevent debris and pressurized water from entering uncoated valve body shaft bore and prevent valve exterior water or contaminations from entering via valve if the pipe experiences a vacuum event. Seal shall prevent an ingress breach if external hydrostatic forces exceed pipe internal pressure. Manual pulldown packing glands or braided packing are not allowed. Outer shaft seals shall be replaceable cartridge type, bolted to valve body and shall not be held in place with an adapter plate or by valve actuator.

j. Shaft Bearings: Shaft bearings shall be corrosion resistant, self-lubricating sleeve type made of bronze, stainless steel or stainless steel backed PTFE. Bearing choice and bearing friction shall be correctly added to valve input torque requirements.

k. Strength: The proportion and dimensions of all parts of the valve and actuator shall be designed to withstand, without failure, the stresses occurring under the testing and operating conditions. The maximum allowable stress in any material shall not exceed 1/5 of the ultimate tensile strength or 1/3 of the minimum yield strength. Class 150 valves shall be capable of withstanding a one-time pressure test of 300 psi applied to one side of the disc with zero pressure applied to the other side of the disc while in the closed position, without damage or permanent deformation to any part of the valve, seat, disc or shaft. The valve shall be capable of withstanding such pressures in both directions.

l. All fasteners and hardware shall be Type 316 stainless steel.

m. Paint and Coatings:

    1) Valves 24 Inches and Smaller: Fusion bonded epoxy line and coat all external and internal surfaces (except seating surface). Coating damaged in shipping or installation shall be noted and properly repaired.

2) Valves Larger than 24 Inches: All external and internal surfaces shall be coated with a minimum of 10 mils of an NSF61 approved two part liquid epoxy. All sharp edges to be coated shall be beveled/radiused to assure consistent coating thickness. The coating inspection report will include inspection of at least six locations where the edges are most sharp and through the complete circumference of the disc edge to assure proper coating and compliance. Compliance of proper beveling of all sharp edges with proper coating of carbon steel valves will be strictly enforced as a condition of providing a proper continuous water service valve.

n. Manufacturers and Products:
   1) VAG Armaturen - Evanston Illinois/Manheim Germany, VAG EKN (double eccentric rubber seated).
   2) AVTEK DEX Double Eccentric Butterfly Valve.
   3) Erhard Double Eccentric Butterfly Valve.
   4) "Or-equal."

D. Check Valves:

1. Type V696 Check Valve:
   a. Elastomer type flanged check valve. Valve shall be manufactured of Type 316 stainless steel with NSF 61 neoprene elastomer check flaps. Flange shall be drilled ASME B16.1, Class 125 flat face.
      1) Manufacture and Products: Red Valve Co.; Water Flex Model WF-3, "or-equal."
2. Type V746 Combination Air Release Valve (CARV) 4 Inch to 6 Inches:
   a. Suitable for water service, combines the operating features of both 1) an air and vacuum valve and 2) an air release valve. Air and vacuum portion to automatically exhaust air during filling of system and allow air to re-enter during draining or when vacuum occurs. The air release portion to automatically exhaust entrained air that accumulates in system. Valve bodies shall be cast- or ductile iron with stainless steel float and trim, built and tested to AWWA C512.
   b. 4 Inch and Larger: Valve shall consist of an air and vacuum valve with a separated air-release valve attached to it. Air and vacuum portion shall automatically exhaust air during filling of system and allow air to re-enter during draining, or when vacuum occurs. Air release portion shall automatically exhaust from system any entrained air through a 3/32-inch orifice. Connect air release valve to air and vacuum valve with standard weight THD stainless steel pipe and manufacturer-supplied ball valve (V307, "or-equal").
   c. Isolation: Mount CARV on manufacturer-supplied ASME B16.1 Class 125 flanged isolation valve (V504, "or-equal").

d. CARV and Isolation Valve Assembly: All components shall seal drip tight with 250 psi pressure across each valve seat and pipe joint.
e. Seating Durometer:
    1) Provide seating durometer material suitable for the following operating pressures:
        a) Operating Pressure Range for Valve Vault: 3 psi to 20 psi.
f. Potable Water CARV Vent Piping: Connect top of the air and vacuum valve to above grade gooseneck vent with water-tight piping. Buried and in-vault vent piping shall be Schedule 80 PVC. Above grade (and concrete encased) vent pipe shall be galvanized steel. Transition PVC to STL with GE or hard rubber coupling. On vent pipe, plus or minus 1.5 inches above vacuum valve, install 1/2-inch tap and SST Ball Valve to allow draining water from vent pipe.
g. Manufacturer and Products: Val-Matic Valve; Series 201C to Series 206C.

2.05 OPERATORS AND ACTUATORS

A. Manual Operators:

1. General:
    a. For AWWA valves, operator force not to exceed requirements of the applicable valve standard.
    b. For non-AWWA valves, operator force not to exceed applicable industry standard or 80 pounds, whichever is less, under any operating condition, including initial breakaway. Provide gear reduction operator when force exceeds requirements.
    c. Operator self-locking type or equipped with self-locking device.
    d. Position indicator on quarter-turn valves.
    e. Worm and gear operators one-piece design, worm-gears of gear bronze material. Worm of hardened alloy steel with thread ground and polished. Traveling nut type operator’s threaded steel reach rod with internally threaded bronze or ductile iron nut.
2. Exposed Operator:
    a. Galvanized and painted handwheel.
    b. Cranks on gear type operator.
    c. Chain wheel operator with tieback, extension stem, floor stand, and other accessories to permit operation from normal operation level.
    d. Valve handles to take a padlock, and wheels a chain and padlock.

3. Buried Operator:
    a. Buried service operators on valves larger than 2-1/2 inches shall have a 2-inch AWWA operating nut. Buried operators on valves 2 inches and smaller shall have cross handle for operation by forked key. Enclose moving parts of valve and operator in housing to prevent contact with the soil.
    b. Buried service operators to be grease packed and gasketed to withstand a submersion in water to 20 feet minimum.
    c. Design buried service operators for quarter-turn valves to withstand 450 foot-pounds of input torque at the Fully Open or Fully Closed positions.
    d. Buried valves shall have extension stems, bonnets, and valve boxes.

2.06 ACCESSORIES

A. T-Handled Operating Wrench:

1. Two each galvanized operating wrenches, 4 feet long.
2. Manufacturers and Products:
    a. Mueller; No. A-24610.
    b. Clow No.; F-2520.

B. Cast-Iron Valve Box: Designed for traffic loads, sliding type, with minimum of 5-1/4-inch ID shaft.

1. Box: Cast iron with minimum depth of 9 inches.
2. Lid: Cast iron, minimum depth 3 inches, nonlocking type, marked WATER.
3. Extensions: Cast iron.
4. Two-piece box and lid for valves 4 inches through 12 inches, three-piece box and lid for valves larger than 12 inches with base sized for valve.
5. Valve extension stem for valves with operating nuts 3 feet or greater below finish grade.
6. Manufacturers and Products:
    a. East Jordan Iron Works; Cast-Iron Valve Boxes.
    b. Bingham & Taylor; Cast-Iron Valve Boxes.

PART 3 EXECUTION

3.01 INSTALLATION

A. Flange Ends:

1. Flanged valve bolt holes shall straddle vertical centerline of pipe.
2. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

B. Screwed Ends:

1. Clean threads by wire brushing or swabbing.
2. Apply joint compound.

C. Valve Installation and Orientation:

1. General:
   a. Install valves so handles operate from fully open to fully closed without encountering obstructions.
   b. Install valves in location for easy access for routine operation and maintenance.
   c. Install valves per manufacturer’s recommendations.
2. Gate, Globe, and Ball Valves:
   a. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.
   b. Install operating stem horizontal in horizontal runs of pipe having centerline elevations greater than 4 feet 6 inches above finish floor, unless otherwise shown.
3. Butterfly Valves:
   a. Unless otherwise restricted or shown on Drawings, install valve a minimum of 8 diameters downstream of a horizontal elbow or branch tee with shaft in horizontal position.
   b. For vertical elbow or branch tee immediately upstream of valve, install valve with shaft in vertical position.
   c. For horizontal elbow or branch tee immediately upstream of valve, install valve with shaft in horizontal position.
   d. When installed immediately downstream of a swing check, install valve with shaft perpendicular to swing check shaft.
   e. For free inlet or discharge into basins and tanks, install valve with shaft in vertical position.

4. Check Valves:
   a. Install valve in horizontal or vertical flow (up) flow piping only for liquid services.
   b. Install valve in vertical flow (up) piping only for gas services.
   c. Install swing check valve with shaft in horizontal position.

D. Extension Stem for Operator: Where depth of the valve operating nut is 3 feet or greater below finish grade, furnish an operating extension stem with 2-inch operating nut to bring operating nut to a point within 6 inches of finish grade.

3.02 TESTS AND INSPECTION

A. Valve may be either tested while testing pipelines, or as a separate step.

B. Test that valves open and close smoothly under operating pressure conditions. Test that two-way valves open and close smoothly under operating pressure conditions from both directions. Installation Contractor shall successfully cycle three times, manually and remotely, butterfly valves with electric motor actuators.

C. Inspect air and vacuum valves as pipe is being filled to verify venting and seating is fully functional.

D. Count and record number of turns to open and close valve; account for any discrepancies with manufacturer's data.

E. Set, verify, and record set pressures for relief and regulating valves.

F. Each valve shall be tested for leakage both in factory and by installation contractor on project site during project startup. When shut, valves shall have zero leakage per API 598, except as follows. Resilient seated valves (including rubber seated ball valves, plunger valves and gate valves) shall have not visible leakage. All other valves shall have less than half the leakage API 598 allows (less than one drop per minute per inch diameter of valve).

G. Installation Contractor shall test all pressure reducing valve functions and document flows and changes during three remote control changes of downstream pressure setting, and resultant valve opening or closing.

3.03 MANUFACTURER'S SERVICES

A. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

END OF SECTION

SECTION 40 27 03
ELECTRIC MOTOR ACTUATORS

PART 1 GENERAL

1.01 DESCRIPTION

A. Use intelligent electric motor actuators unless specifically required otherwise.

B. This section includes materials, installation and testing of electric actuators for valves in accordance with AWWA C542, except as modified below. The electric motor actuator shall include any necessary intermediate gearing between the electric actuator and the valve to which it is attached.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Painting and Coating: Section 09 90 00, Painting and Coating.

B. Valves and Operators: Section 40 27 02, Valves and Operators.

1.03 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA): C540, Power Actuating Devices for Valves and Sluice Gates.
2. National Fire Protection Association (NFPA): National Electrical Code, 2011 Edition.

1.04 SUBMITTALS

A. Action Submittals:

1. Submit complete manufacturer's descriptive information on each actuator and accessory. Provide actuator parts and materials of construction, referenced by AISI, ASTM, SAE, or CDA specification and grade.
2. Dimensions and weights.
3. Coatings.
4. Submit motor data including name plate data, insulation type, output torque, voltage, phases, frequency, current at running torque, and locked rotor, duty rating, and travel times open to close and close to open.
5. Show the maximum torque required to open and to close each motor-actuated valve or cast iron sluice gate.
6. Coordinate torque requirements with gate and valve manufacturers to provide an actuator that meets Specification requirements.

7. Submit electrical schematic drawings and physical wiring diagrams showing all power and control interfaces.
8. Submit information showing the relationship between the operator output torque and the torque limit switch settings.
9. Provide valve versus actuator arrangement drawing confirming orientation of actuator and maintenance/operation access. Obtain Owner's written approval prior to installation and mounting.

B. Informational Submittals:

1. Certification from actuator manufacturer, that actuator meets or exceeds all part of this section.
2. Factory and field test reports.
3. Operation and Maintenance Data:
    a. Manuals shall include the following:
        1) Complete installation instructions.
        2) Operating and maintenance instructions.
        3) Complete parts list.
        4) Part change-out instructions.
        5) The theory of operation for the actuator and the intermediate gearing.
        6) Expanded parts drawings, showing all mechanical and electrical parts.
        7) Electrical schematic drawings and physical wiring diagrams showing all components.
        8) Drawings of electrical component enclosure-physical layout in 3-D view.
        9) List of recommended spare parts.
        10) List of special tools for installation, maintenance, and adjustments.
        11) Lubrication guide with a list of recommended lubricants.
4. Copies of factory training certifications, from actuator manufacturer, for any maintenance or installation technicians, Training certifications shall be specific to the models installed. Certificates shall be approved by the Construction Manager before technicians are authorized to perform any work on the valve actuators.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide 240 volt single phase “Intelligent Electric Motor Actuator” that is recommended by, and shop attached (and tested) by, the valve manufacturer.

B. Manufacturers:

1. AUMA.
2. Rotork.
3. “Or-equal.”

2.02 ACTUATOR IDENTIFICATION

A. Identify electric motor actuators by tag number as shown in Electric Motor Actuator Schedule. Identification tags shall be round or oval aluminum tags attached to the actuators with aluminum wire. Tag numbers shall be engraved or stamped on tags in block letters.

2.03 GEARED OPERATORS

A. Geared operators shall be per Section 40 27 02, Valves and Operators, and the following.

B. Intermediate Geared Operators:

1. Provide intermediate operators of spur, helical, or bevel gears, between the new electric motor actuator and the new or existing geared valve operators, if needed to provide the specified open/close time, and to provide continuous operation of valve (from full open to full close) without electrically pulsing the actuator. Intermediate geared operators shall be designed with bearings suitable for adapting to an electric actuator. Operators designed with bushings are not permitted.
2. Intermediate geared operators do not need dial indicating valve position, but shall be enclosed, oil or grease lubricated, with seals provided on shafts to prevent entry of dirt and water.
3. Intermediate geared operators shall be totally enclosed design proportioned to permit operation of valve under full differential pressure equal to valve pressure rating with max input of 150 foot pounds on operating shaft, and shall be oriented to operate with valve stem and electric actuator as per Construction Manager.
4. Support gear shaft at each end by ball or tapered roller bearings. Provide reduction gearing to meet max torque and pull design requirement. The reduction gearing shall run in a proper lubricant.

5. Intermediate geared operator shall open valves by turning counterclockwise.

C. Handwheel: Provide handwheel for manual operation with arrow to indicate "open" rotation. Handwheel shall not rotate during motor operation, and operation of handwheel shall not cause motor to rotate. When in manual operating mode, actuator shall remain in this mode until motor is energized, at which time actuator will automatically return to electric operation. Movement from motor operation to handwheel operation shall be by a positive, pad-lockable declutching lever, which mechanically disengages motor and related gearing. Friction type declutch mechanisms are not acceptable. Size handwheel for a maximum pull of 50 pounds under full differential pressure at any point through valve travel including seating and unseating.

2.04 MOTORS FOR ELECTRIC ACTUATORS

A. Provide totally enclosed, high- torque, nonventilated, single-phase, or three-phase motors, suitable for the facility electrical service shown on Drawings. NEMA service factor rating shall not be used in rating motors for maximum load conditions.

B. Unless noted otherwise, motors for actuators shall be specifically designed and rated for 10-minute operating times (open to close and close to open).

C. Provide Class F or Class H insulation specifically designed for valve actuation service and rated for continuous duty operation and 1,200 start/stops per hour without overheating. Heat rise after 1,200 start/stops in an hour shall be less than 50 degrees C. Heat rise after three full consecutive valve cycles shall be less than 50 degrees C. If travel time requirements would cause the three-cycle test to extend beyond 60 minutes, limit the test to 60 consecutive minutes. Design actuator so it can cycle valve (or gate) from closed to open and back to closed every 10 minutes.

D. Provide motor output capacity sufficient to open or close the valve against the maximum differential pressure when the voltage is 10 percent above or below normal at the specified service conditions.

E. Motor bearings shall be of the anti-friction type and permanently lubricated.

F. Provide over temperature protection with thermostat sensor. Sensor shall automatically reset on cooling.

2.05 ACTUATOR TORQUE REQUIREMENTS

A. Provide actuator with rated output torque at least 1.5 times the maximum torque required to operate the valve in any position, including seating and unseating conditions and neglecting hammer-blow effect.

B. Maximum torque requirement is defined as torque required at the most severe operating conditions, including max differential pressure across the valve (defined at the valve pressure rating), and max mechanical friction or other restrictive conditions inherent in the valve assembly. Except where noted otherwise, the maximum line velocity is defined as the flow identified on Drawings and specifications for each valve and pipe. For line water temperature, assume a range of from 40 degrees F to 100 degrees F.

C. Actuator maximum torque shall be calculated with the applied voltage 10 percent below nominal motor voltage rating.

D. Coordinate with the valve manufacturer to assure that the motor actuator stall torque output does not exceed the torque limits of the valve operating stem or shaft.

2.06 ELECTRICAL CHARACTERISTICS

A. Operating Speed and Indication:

1. Unless noted otherwise, design actuators for modulating operation (open to close and close to open, 15-minute travel time).
2. Design valve actuators for open/close operation and continuous modulating service to regulate flows.
3. Actuator shall have a built-in device that allows motor to reach full speed before engaging valve load. This hammer blow feature shall be engaged if the actuator is in handwheel or motor operation.

B. Actuator Housing:

1. Housing shall be NEMA 6.
2. Electrical motor and other electrical elements of the actuator shall be gas and water-tight when the terminal cover is removed.
3. All torque limits, limit switch adjustments, and other configuration shall be carried out without any removal of actuator covers. Configuration shall be available by remote device or at the actuator user interface.
4. Enclosures shall have at least two 1-inch minimum NPT threaded hubs for conduit entry.

C. Power Transmission:

1. Provide actuator with internal, multiple reduction power gearing unit, consisting of spur or helical gears and work gearing of hardened alloy steel, with the worm gear of alloy bronze. Manufacture all power gearing accurately.
2. Provide self-locking work gear set in the drive train to maintain valve position.
3. Use anti-friction bearings with caged ball or roller throughout.
4. All rotating power train component are to operate immersed in grease or oil with provisions for inspection and relubrication without disassembly.
5. Lubricants shall be suitable for ambient conditions of minus 20 degrees F to 150 degrees F. Adequate seals shall be provided on all shafting.
6. Actuator noise shall not exceed 72 dBA at all times within a 3-foot radius.
7. Design shall permit gear case to be opened for inspection or disassembles without releasing stem thrust or taking the valve out of service.

2.07 INTELLIGENT ELECTRIC MOTOR ACTUATORS (REQUIRED FOR ALL ELECTRIC ACTUATORS)

A. General Design:

1. Provide wired control communication capability for all components.
2. Include as one integral assembly, the motor, internal reduction gearing, position limit switch functions, torque switch functions, travel limit switch functions, position indicator, declutch lever, handwheel, solid state reversing starter and operator controls.
3. Actuator shall be an intelligent, microprocessor-based design suitable for service for temperatures from minus 30 degrees C to plus 70 degree C.
4. Calibration and setup features shall be available by a nonintrusive front panel interface and handheld setting tool, accessible without requiring removal of covers or use of special tools.
5. Connect electric motor to actuator by a plug-in electrical connector. Motor shall be removable without draining oil or grease from gearbox.

B. Control Interface:

1. Actuator shall:
   a. Be configurable for direct-wired remote open/close control, using 24V dc command lines. Control shall interrogate remote dry contacts providing open/close control.

b. Both accept and supply 24V dc control power for remote control. Internal actuator power supplies shall be automatically protected against overcurrent or short circuit conditions.
c. Allow programming of all programmable features via front panel nonintrusive switches and local display.
d. Actuator shall be equipped and configured for remote wire control for configuration, monitoring, and control.
e. Allow access to all programmable features via a laptop computer connected directly to actuator. If software other than terminal emulator is required for access, then software and cable shall be provided at the time of delivery.
f. Actuator shall provide torque trending graphs in local mode. The actuator shall be capable of displaying a torque graph in both "Reference" and "Recent" modes and shall be able to be viewed in "Local" actuator diagnostic mode. The reference graph mode shall be User selectable as a baseline, and the recent graph displayed shall be the torque generated during the last performance cycle. The User shall be able to select any of the recent graphs to replace the reference graph. Torque shall be digitally displayed in the Diagnostics menu labeled "Torque Profile." Torque shall be collected in either open or closed directions."

C. Local/Remote Interface:

1. Actuator shall have a local interface/display screen capable of displaying at least 32 alphanumeric characters and a 0 percent to 100 percent display for valve position readout. All text messages or displays shall be in English.
2. Actuator shall have a local LOCAL-STOP-REMOTE (LSR) mode control switch, and a local OPEN- CLOSE (OC) position command switch. The LSR switch shall be lockable in any position by using a standard padlock.
3. Local and remote programming interfaces shall be protected by user-selectable password protection for all programmable features.
4. The local control switches shall not penetrate the actuator enclosure, and shall electrically isolate the operator from any external voltages.
5. The OC function shall be user-configurable for maintained or inching control.

6. Provide four status contacts, minimum, for remote indication of valve position. These contacts shall be configurable for normally-open or normally-closed function. These contacts shall be programmable for operation at any position between full open and full closed position, or shall be programmable to indicated any of the following: Mid-travel, local mode, over torque, motor over temperature, manual operation, remote mode, valve moving, close torque switch, open torque switch, hardware failure, or valve jammed. These contacts shall be rated 250V ac/30V dc, 5 amps.

D. Position/Limit/Torque Sensors:

1. Actuators shall employ noncontact-type absolute position encoders, capable of at least 18-bit resolution. Position encoders shall sense actual valve position at all times, during electrical or handwheel operation, with or without applied electrical power, and without the use of batteries. The encoder maximum error shall be less than 1 percent and shall include, repeatability, linearity, and positional accuracy throughout the entire range of motion.
2. Open and close valve travel-limit positions shall be a function of the absolute position encoder, shall be stored in permanent, nonvolatile memory, and shall be easily adjustable from the local or remote interface.
3. Torque shall be measured employing a nonmechanical, fully electronic sensor. The motor-torque limit shall be adjustable over 40 percent to 100 percent of design torque in 1 percent increments.
4. The motor shall automatically de-energize if an over-torque condition is sensed. Torque limit protection shall automatically adjust for initial valve unseating, or for programmed torque seating of valves. A valve movement in the opposite direction of the over torque move shall reset the torque limit protection.
5. The actuator shall provide a 4 mA to 20 mA analog output signal for valves that are position controlled and a digital open and closed status for all others to indicate valve position. This signal shall employ the noncontact type absolute position encoders and conform to the accuracy requirements of this section.

E. Intelligent Control Module: Intelligent control module shall:

1. Be of a modular design, with replaceable circuit boards for troubleshooting.
2. Be entirely housed in actuator, and shall be easily accessible for maintenance.
3. Have control circuit boards or modules that connect with plug-in card connectors or wiring plugs.

4. Include a solid-state motor reversing circuit for modulating up to 1,200 starts per hour. Mechanical reversing contactors are acceptable for modulating up to 600 starts per hour. Failure of the solid-state motor reversing or EM contactor module shall not result in unintended motor operation.
5. Include any necessary internal protection fuses. No external or accessory fuses shall be required for full protection of the motor or control electronics package.
6. Have solid-state motor reversing circuit that does not affect actuator performance, or degrade communications between actuator and remote control equipment.
7. Be capable of 300 starts per hour for modulating service.
8. All control transformers shall include vacuum impregnated coils, and have dual primary fuses.
9. Include an automatic directional reversal delay, to prevent current surges from rapid motor reversal.
10. Incorporate an automatic phase-correction circuit to correct motor rotation errors due to incorrect site wiring.
11. Include an automatic phase-failure detection circuit that shall disable motor rotation if a phase-loss is detected.
12. De-energize motor when it detects a fault or fails.
13. Allow actuator calibration without removing covers or requiring special tools.
14. Allow actuator calibration by answering simple questions on operator display.
15. Accumulate and store diagnostic information about actuator performance including, motor, position encoder, contractor performance, cycle time, handwheel operations, actuator identification, output turns, and a torque profile of valve baseline stroke and the last valve stroke for comparison.

F. Power/Control Wiring:

1. All customer connections shall be in a compartment that is separate from the control circuits and other internal spaces. Accessing the wiring compartment shall not require opening any other actuator compartments.
2. The wiring connections compartment shall contain a suitable number of screw-type terminals to allow connection of step-mode controls wiring and the control wiring shall be physically separated from the power wiring.

2.08 DRIVE SLEEVE

A. Provide a drop-in stem nut held in place with a snap ring, torque bushing, or threaded locknut and keyway which couples with actuator to the intermediate geared operator or valve stem and provides a versatile means of disassembling the actuator from the operator or valve. Removable A1 base is acceptable.

2.09 FACTORY TESTING OF MOTOR ACTUATOR

A. Test each actuator (when fully attached to valve) prior to shipment in accordance with AWWA C540. Submit certified test reports. The application torque shall be the maximum torque required to open or close the valve at any position, including seating and unseating conditions.

PART 3 EXECUTION

3.01 ATTACHING ELECTRIC ACTUATORS

A. Protect actuators from damage per manufacturer recommendations at all times. Replace (at no cost to Owner) all electrical enclosures and electrical components found with condensation or related damage.

B. Valve manufacturer shall mount electric motor actuator and accessories on each valve and stroke the valve prior to shipment. Provide preliminary configuration and adjustment of all functions, including limit switches, valve position transmitter, and torque switches.

C. Valve manufacturer shall provide installation, configuration, and testing of each valve actuator by actuator manufacturer-certified technicians. Actuator mounting arrangements shall facilitate operation and maintenance and shall be as indicated, and as verified and acceptable to valve manufacturer and Owner. Provide certification that valve actuators have been installed and adjusted by valve manufacturer. The actuator access cover shall be oriented to prevent the cover from falling in the workspace, causing injury to personnel.

3.02 PAINTING AND COATING

A. Coat the exterior metal surfaces of electric motor actuators per Section 09 90 00, Painting and Coating. Provide rust inhibiting inorganic zinc-rich primer and intermediate and finish coats of high-build epoxy recommended by manufacturer of the equipment.

3.03 FIELD INSTALLATION

A. Install the valve and actuator as indicated on Drawings in accordance with the manufacturer's instructions. Keep units dry, closed, and sealed to prevent internal moisture damage during construction. Provide additional hangers and supports for actuators which are not mounted vertically over the valve or which may impose an eccentric load on the piping system.

3.04 FIELD TESTING OF ELECTRIC MOTOR ACTUATORS

A. Only maintenance technicians that are certified by the actuator manufacturer shall be employed to perform any field testing, adjustment, or set up of the valve actuator.

B. The motor actuators shall be tested, as installed by measuring the current drawn (in amperes) by each motor for unseating, seating, and running conditions. The measured current shall not exceed the current measurement recorded during the factory performance test by more than 5 percent.

C. If the measured current drawn exceeds the above value, provide a larger motor or gear drive or adjust the actuator so that the measured amperage does not exceed the value.

D. Verify that absolute encoder functions are adjusted to their correct settings. Open and close valves twice and assure that absolute encoder functions. Verify the position transmitters and any other information being developed in the actuator complies with requirements contained within this section or listed on Drawings.

E. Electric motor actuator manufacturer or qualified representative shall be available at the work site to check installation, supervise startup, and conduct field testing and adjustment of equipment. Provide factory-authorized formal training in the operation and maintenance of the equipment to Owner personnel, such that Owner personnel shall be qualified by the equipment manufacturer to maintain their equipment. Documentation of their qualification shall be provided as part of the training package.

3.05 ELECTRIC MOTOR ACTUATOR WARRANTY

A. The electric motor actuator manufacturer shall warrant its product to be free from defects in materials, workmanship and performance for actuator incorporated in the work for a period of 5 years from the date of Substantial Completion or final acceptance, whichever occurs first. Upon notice by the Owner, any damage or defect found during the warranty period shall be promptly repaired or replaced by the manufacturer at no cost to Owner.

B. In emergency situations, if warranty service is not immediately available from the Vendor/Supplier or Manufacturer, the Owner will perform repairs to re-establish proper operation of the actuator and valve. All defective parts returned by Owner shall be replaced with new parts. If the Owner replaces the entire actuator for cause, the Vendor/Supplier or Manufacturer shall repair or replace the entire actuator.

C. Maintenance or repair work performed by Owner during the warranty period shall not be cause for voiding the warranty.

3.06 SUPPLEMENT

A. The supplement listed below, following "End of Section," is part of this Specification.

1. Electric Motor Actuator Schedule.

END OF SECTION

ELECTRIC MOTOR ACTUATOR SCHEDULE						
Valve Type - #	**Valve Size (in)**	**Process Fluid**	**Maximum ΔP (psi)**	**Service**	**Travel Time (Minutes)**	**Control Feature Modifications/ Supplements**
BFV-01	30	Water	250	O/C	10	B, C, D, F, H, I
BFV-02	30	Water	250	O/C	10	B, C, D, F, H, I

Service: O/C = Open-Close, T = Throttling, M = Modulating

Control Feature Modifications/Supplements:

A = Actuator shall open valve upon loss of signal.

B = Actuator shall remain in last position upon loss of signal.

C = Local OPEN-CLOSE momentary pushbuttons that must be continuously depressed to initiate/maintain valve travel; travel stops when pushbutton is released or when end of travel limit is reached.

D = Remote OPEN-CLOSE maintained dry contacts; travel stops when remote contact opens, or when end of travel limit is reached. (4-20mA position).

E = Three 24V dc interposing relays for remote OPEN-STOP-CLOSE control. Relays powered externally, thereby permitting valve control from greater distances.

F = Motor and control enclosure(s) NEMA 250, Type 6 (IP 68) and Type 4.

G = Motor and control enclosure(s) NEMA 250, Type 7.

H = Valve position output converter that generates an isolated 4 mA to 20 mA dc signal in proportion to valve position, and is capable of driving into loads of up to 500 ohms at 24V dc.

I= Operation from 240-volt, single-phase power.

J= Local OPEN-CLOSE momentary selector switch that must be momentarily switched to initiate valve travel; travel stops when selector switch is switched to stop position or when end of travel limit is reached.

SECTION 40 80 01
PIPING LEAKAGE TESTING

PART 1 GENERAL

1.01 DESCRIPTION

A. Hydrostatic and leakage test pipe and its appurtenances (except drain pipes) per this section.

1.02 SUBMITTALS

A. Submit Hydrostatic Testing Plan that includes detailed procedure for testing piping. Plan shall include identification of source water for testing, filling and draining plan, equipment to be used for testing including pumps, flowmeters, and pressure gauges.

B. Submit Shop Drawings in accordance with Section 01 33 00, Submittal Procedures.

C. Submit test bulkhead locations and design calculations, pipe attachment details, and methods to prevent excessive pipe wall stresses.

D. Submit copies of the test records to the Engineer upon completion of the testing.

1.03 TEST PRESSURES

A. Test pressures for piping shall be as shown on Drawings.

1.04 TESTING RECORDS

A. Provide records of each piping installation during the testing. These records shall include:

1. Date and times of test.
2. Identification of process, pipeline, or pipeline section tested or retested, pipe material and pipe specification.
3. Test fluid.
4. Test HGL.
5. Remarks: Leaks identified (type and location), types of repairs, or corrections made.
6. Certification by Contractor that the leakage rate measured conformed to the Specifications.

PART 2 PRODUCTS (NOT USED)

2.01 NOTIFICATION

A. Notify Engineer of test start date 14 days before test start.

2.02 MANUAL AIR-RELEASE VALVES FOR BURIED PIPING

A. Provide temporary manual air-release valves at test bulkheads for pipeline test. Construct the pipe outlet in the same manner as for a permanent air valve and after use, seal with a blind flange, pipe cap, or plug and coat the same as the adjacent pipe.

2.03 TEST BULKHEADS

A. For steel pipe fabricate test bulkheads per Section VIII of the ASME Boiler and Pressure Vessel Code (or use DIP test heads). Materials shall comply with Part UCS of said code. Unless shown otherwise on Drawings, design pressure shall be at least 2 times the specified test pressure for the section of pipe containing the bulkhead. Limit stresses to 70 percent of yield strength of the bulkhead material at the bulkhead design pressure. Include air-release and water drainage connections.

2.04 TESTING FLUID

A. Testing fluid shall be clean potable water only.

B. The Contractor shall obtain water as Specified in Section 33 13 00, Disinfection of Water Utility Distribution Facilities.

C. Obtain all permits required by regulatory agencies.

2.05 TESTING EQUIPMENT

A. Furnish testing equipment and perform tests in manner satisfactory to Engineer. Provide calibrated pressure gauges, pipes, bulkheads, pumps, compressors, chart recorder, and meters to perform the hydrostatic testing. Testing equipment shall provide observable and accurate measurements of initial service leak and allowable makeup water volume under specified conditions.

PART 3 EXECUTION

3.01 TESTING PREPARATION

A. Pipes shall be in place, backfilled, and anchored before commencing pressure testing. Verify that all air vacuum valves are functioning prior to commencing pressure testing.

B. Conduct pressure tests on exposed and aboveground piping after the piping has been installed and attached to the pipe supports, hangers, anchors, expansion joints, valves, and meters.

C. For buried piping, the pipe may be partially backfilled and the joints left exposed for inspection during an initial leakage test. Perform the final pressure test, however, after completely backfilling and compacting the trench.

D. Provide any temporary piping needed to carry the test fluid to the piping that is to be tested. After the test has been completed and demonstrated to comply with the Specifications, disconnect and remove temporary piping. Do not remove exposed vent and drain valves at the high and low points in the tested piping; remove any temporary buried valves and cap the associated outlets. Plug taps or connections to the existing piping from which the test fluid was obtained.

E. Provide temporary drain lines needed to carry testing fluid away from the pipe being tested. Remove such temporary drain lines after completing the pressure testing. Pipes shall remain full after testing.

F. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.

G. Prior to starting the test, the Contractor shall notify the Engineer.

3.02 LENGTH OF TEST SECTION FOR PIPE

A. Hydrostatic test the pipeline and its appurtenances in order to meet the schedule requirements identified in Section 01 31 13, Project Coordination, and as indicated on Drawings.

3.03 INITIAL PIPELINE FILLING FOR HYDROSTATIC TESTING

A. Maximum rate of filling shall not cause water velocity in pipeline to exceed 0.25 fps (assuming full pipe flow).

3.04 TESTING NEW PIPE WHICH CONNECTS TO EXISTING PIPE

A. Prior to testing new pipelines which are to be connected to existing pipelines, isolate the new line from the existing line by means of test bulkheads, spectacle flanges, or blind flanges. After the new line has been successfully tested and disinfected per Specification Section 33 13 00, Disinfection of Water Utility Distribution Facilities, remove test bulkheads or flanges and connect to the existing pipe. Final closure piece shall include minimum 3 feet of cut to fit pipe.

3.05 HYDROSTATIC TESTING OF STEEL PIPING

A. Where any section of the piping contains concrete thrust blocks or encasement, do not make the pressure test until at least 14 days after the concrete has been placed. When testing mortar-lined piping fill the pipe to be tested with water and allow it to soak for at least 48 hours to absorb water before conducting the pressure test.

B. Apply and maintain the test pressure by means of a positive displacement hydraulic force pump.

C. Maintain the test pressure for a minimum 4-hour duration by restoring it whenever it falls an amount of 5 psi.

D. After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure. This amount of water is the loss due to leakage in the piping system. The allowable leakage is zero for welded steel pipelines.

3.06 REPETITION OF TEST

A. If the actual leakage exceeds the allowable on any test, locate and correct the faulty Work and repeat the test. Restore the Work and all damage resulting from the leak and its repair. Pay for water needed for retesting.

3.07 DISPOSAL OF CLEANING WATER AND TEST WATER

A. See Section 33 13 00, Disinfection of Water Utility Distribution Facilities, for cleaning requirements. Submit and obtain Engineer approval for Contractor method for treating water remaining from cleaning of pipeline.

3.08 FIELD QUALITY CONTROL

A. Test Report Documentation:

1. Test date.
2. Description and identification of piping tested.
3. Test fluid.
4. Test pressure.
5. Remarks, including:
   a. Leaks (type, location).
   b. Repair/replacement performed to remedy excessive leakage.
6. Signed by Contractor and Owner to represent that test has been satisfactorily completed.

END OF SECTION

DRAWINGS
(BOUND SEPARATELY)